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# SOME NEUROLOGIC COMPLICATIONS OF THE EAR, NOSE AND THROAT *

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It is impossible to discuss adequately in a short paper all of the possible nervous complications of the ear, nose and throat. I shall speak only of a few. During the past eight years, I have been lecturing to students taking courses in these specialties at the Graduate School of the University of Pennsylvania, and the students, as well as I, have been surprised at the great number of points that are of common interest.

The importance of the relationship of the ear to the nervous system can perhaps be best expressed in the fact that there has appeared recently, under the editorial supervision of Prof. G. Alexander, Prof. O. Marburg and Dr. H. Brunner, all of Vienna, an excellent three volume work on the neurology of the ear.[1]

## INVOLVEMENT OF THE OPTIC NERVE IN DISEASE OF THE SINUS

The association of optic atrophy, optic neuritis and choked disk with nasal conditions has received a great deal of attention in recent years. The percentage of such involvement varies, according to different authors. Some rhinologists, notably Sluder, assume that this is common, whereas others deny it.

As a result of the pathologic work of Dr. Jonathan Wright, Sluder assumes that the optic nerve is involved either by pressure due to soft parts, extension of the inflammation, vascular congestion, or by a thickening process produced by osteitis or periostitis with pressure on the optic nerve. Prompt relief of pressure will cause a lessening of the symptoms, whereas if the pressure is not relieved, optic atrophy will

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1. Alexander, G.; Marburg, O., and Brunner, H.: Handbook of the Neurology of the Ear, Berlin, Urban and Schwarzenberg, 1926, p. 825.

follow. Not all cases of optic neuritis, however, can be explained in this way, for in many instances no demonstrable lesions in the sinuses can be found, yet an operation on the sinuses somehow improves vision. It is possible that in such cases there may be a so-called toxic influence exerted on the optic nerve. Much as I dislike the word "toxic," no better explanation can be found.

Retrobulbar optic atrophy is much more common than optic neuritis. According to ophthalmologists, such an atrophy can occur secondary to implication of the sinus without direct involvement of the optic nerve itself. Here again the toxic theory is used for want of a better explanation. I wish to call attention to the fact that primary optic atrophy never occurs following disease of the sinus, although this statement has been made repeatedly in the literature.

Sluder records a number of cases in which choked disk has varied from 1 to 8 diopters. Cushing denies the possibility of the production of choked disk by postethmoidal or sphenoidal lesions, and justly calls attention to the fact that choked disk is present only on increase of intracranial pressure; this is the understanding that most neurologists and ophthalmologists have.

I have seen optic neuritis of a moderate degree occurring in postethmoidal and sphenoidal lesions, but never more than of 2 or 3 diopters. I have never seen a frank choked disk. It is difficult to accept Sluder's statement that he has seen swelling of 8 diopters in disease of the sinus, for such a choked disk generally indicates a lesion in the posterior cranial fossa.

The statement made by Sluder that the diagnosis of optic neuritis accompanying disease of the sinus is nearly always made by exclusion and that sometimes it is justifiable to operate on these patients before a neurologic diagnosis is made, does not rest on a firm foundation. He further states that the explanation as to why he sees so many cases is that neurologists are apt to be satisfied with a diagnosis of neurasthenia or hysteria when the picture is not that of a classic organic nerve lesion, and that rhinologists are prone to declare the nose normal when it does not show a frank suppuration of the sinus.

On the other hand, neurosurgeons complain that so many patients with tumor of the brain are brought to them on whom nasal operations have been needlessly done. Neglect of neurologic investigation was the chief fault. I can only emphasize the foregoing statements. I have a record of a number of instances in which competent rhinologists have opened up the sinuses for the relief of involvement of the optic nerve, in which subsequent neurologic examination, which was made necessary by the condition of the patient, demonstrated tabes dorsalis or tumor of the brain. From the neurologic standpoint, I cannot admit the necessity of a hurried operation on the sinus in the presence of choked disk

without a competent neurologic examination. The experience of all neurosurgeons and neurologists is such that sufficient emphasis cannot be laid on this point.

### PAIN IN THE FACE

There is nothing more difficult to determine than the etiology of pains in the face resulting from causes other than frank involvement of the fifth nerve. Because in so many instances either alcoholic injection into the branches of the fifth nerve or cutting of the sensory root of the fifth nerve, with or without removal of the gasserian ganglion, has not produced alleviation of the pain, neurosurgeons are more careful in their choice of operative material, and have sought for other explanations for the pains.

Such pains can be explained on only one of three theories. The first theory is that the pain is the result of involvement of the ninth nerve. There have now been a sufficient number of cases reported in the literature to show that inflammation of the glossopharyngeal nerve will cause pain in the lower part of the face, tongue and throat. The explanation lies in the fact that the ninth and fifth nerves supply contiguous sensory areas, and that it is conceivable that in an inflammation of either, pain may be present in the parts supplied by both, i. e., in the lower part of the face, tongue and throat. I reported the first case of this kind in a patient in whom the fifth nerve, the lingual nerves and the cervical nerves were all cut, and at autopsy the ninth nerve was found degenerated. Since that time, the syndrome of the pains in the ninth nerve has been well established in the literature.

The second explanation for pains, especially in the upper part of the face, has been offered by Sluder, who states that, because of involvement of the nasopalatine ganglion, there is a typical sydrome consisting of pain starting in the ala of the nose, running along the zygoma to a point back of the ear, down the neck and shoulder and sometimes to the arms. The involvement of the sphenopalatine ganglion does not always give pain in the entire distribution. It may be present only in a part of the path. Sometimes, instead of pains, only vasomotor and secretory phenomena may be found, but these occur less frequently than the painful syndrome. The explanation for this lies in the fact that the nasal ganglion is supplied by the maxillary, which has a sensory branch from the fifth nerve, and the vidian, which is composed of the great superficial and great deep petrosals. The superficial petrosal comes from the geniculate ganglion, bearing motor fibers from the seventh nerve and taste fibers which ultimately reach the brain by the fifth nerve. The great deep petrosal is a sympathetic nerve and comes from the superior cervical sympathetic ganglion. The variation in the symptomatology will depend on whether all or part of the ganglion and its distribution is involved.

My experience with this syndrome has been somewhat disappointing. I have seen cases in which there were typical sphenopalatine pains which in a few instances disappeared altogether as a result of treatment first by cocainization and later by alcoholic injection of the ganglion, but in most cases the results have been disappointing in that, while cocainization has temporarily alleviated the pain, alcoholic injection has not. This does not occur because the injection was not done properly. Sluder admits the possibility of such an experience, and states that in such instances the pathologic change lies central to the ganglion; that is, in the maxillary and vidian nerves secondary to sphenoidal inflammation. In such instances, intrasphenoidal application of pain-reducing remedies, such as cocaine, will stop the pain under these conditions.

My own experience contradicts this point of view, at least in some cases. Recently, for example, in a patient who had what was considered typical nasopalatine syndromes, while cocainization always stopped the pain, alcoholic injection did not. When intrasphenoidal cocainization was tried, the pain ceased for only a short period. As a result, the sinuses were opened but the pain continued. Finally, the infra-orbital nerve was injected with alcohol, and the pain promptly stopped. In other patients with similar pains, radical operations on the fifth nerve finally caused elimination of the pain. Again, in patients in whom at various times cocainization or alcoholic injection of the nasal ganglion caused immediate alleviation of pain, applications of sterile water had similar results.

I have come to the conclusion that there is no doubt that there is such a thing as nasopalatine pain as described by Sluder, but that this syndrome is uncertain. It may be because of variations in the formation of the ganglion. Some neurosurgeons, notably Frazier and Cushing, doubt this syndrome and believe the explanation lies in the spilling over of pain impulses from the fifth nerve.

Recently another theory has been advanced; that is, that the pains are the result of involvement of the sympathetic nerves. This, however, is not altogether clear. Sluder himself hints at such an explanation for some of his cases. The best work on the sympathetic system that has ever appeared is that by André Thomas,[2] who discussed the possibility of sensory fibers in the sympathetic system. He comes to the conclusion that the evidence to date is doubtful. On the other hand, he offers a theory which has probably more basis to it than any so far advanced—that the sympathetic system transmits sensory fibers which have their origin in the posterior ganglions and which go peripherally through the sympathetic system. These sensory fibers may transmit impulses similar

2. An abstract of this article appeared in Arch. Neurol. & Psychiat. **17**:381 (March) 1927.

to the protopathic sensibility described by Head. Definite proof of this is lacking, but here would lie a possible explanation of those instances in which surgeons have reported alleviation of the pain after removal of the sympathetic fibers. On the other hand, caution must be exercised at the present time in indiscriminate operations on the sympathetic nerves merely on a theory that they might do good. The sympathetic system today occupies the same position that neurosyphilis and hysteria did many years ago, when it was the fashion to explain everything that was unexplainable by such involvement. One must not forget that in so many instances irregular pains are of psychogenic origin; this phase of the subject will be discussed later.

### INFLAMMATORY PROCESSES

Such complications resulting from inflammation of the middle ear or the sinuses of the nose are always a cause of anxiety. They are of four kinds: thrombophlebitis of the dural sinuses, meningitis, extradural abscess and abscess of the brain. They occur much more frequently as a result of inflammations of the middle ear than of the sinuses. In order of frequency, as complications of disease of the sinus, there is, first, meningitis; second, abscess of the brain, and third, thrombophlebitis.

Most abscesses of the brain complicating infections of the ear result from chronic inflammation, and it has been estimated that only about 10 per cent are the result of acute infections, such rapid development being consequent to a thrombophlebitis of the sinuses or a pachymeningitis or leptomeningitis. It is, of course, well known that most abscesses of the brain resulting from infections of the middle ear occur in the temporal lobes, the proportion being about from 60 to 70 per cent in this area and about 30 per cent in the cerebellum.

The pathway of infection is usually by direct extension through the dura mater, second, by a thrombophlebitis and third, by the lymphatics.

### MENINGITIS

There is usually no difficulty in diagnosing the onset of meningeal symptoms. The important thing to determine is the presence either of the so-called serous or sympathetic meningitis in which surgical intervention is promptly indicated, and the purulent type in which operative intervention is not of much value. The usual distinction between the two lies in the bacteriologic examination, the absence of the organism usually indicating the serous form. In both, the cerebrospinal fluid may show turbidity, increased pressure and increase in albumin, and the differential cell count may show a predominance of polymorphonuclear leukocytes.

It has been found by experience that the absence of the organism in the first one or two examinations of the cerebrospinal fluid is not always conclusive, for frequently the bacteria will be present at further examinations. On the other hand, experience has also shown that even though the bacteria have been found, the course of the disease is not necessarily fatal, for the meningitis may be circumscribed. The important point after all is the cell count. In the so-called serous type of meningitis, the cell count may run as high as 9,000, whereas in the usual purulent type the count is more than 20,000.

### ABSCESS OF THE BRAIN

I know of nothing more difficult than a correct diagnosis of abscess of the brain. This is equally true of chronic as well as of acute forms, although the acute forms, because of the rapid advance in symptoms, are perhaps more difficult to diagnose. My idea of a difficult problem is that of a child with a history of infection of the middle ear in a comatose condition, without the presence of choked disk, and when there is a reasonable certainty that there is an intracranial complication. In such instances, I have frequently been led astray by the history obtained from the attending otologist. I remember one instance in just such a case as the one outlined, in which the infection of the middle ear was on the left side and in which the examination showed a weakness in the right arm and leg, but in which there was no Babinski reflex and no apparent weakness in the face; yet, because of the presence of the symptoms in the side opposite the source of infection it was presumed that the abscess must be in the left temporomotor area. Operation did not give results, whereas a postmortem examination showed an abscess in the right cerebellum. At the time that I made the examination, I made the observation that the symptoms pointed to a cerebellar lesion on the right side, because of the absence of pyramidal symptoms, and yet the history overbalanced my clinical judgment. Since this experience, I prefer to come to a tentative conclusion before I consider the history.

In chronic cases, abscess of the temporosphenoidal lobe offers the greatest diagnostic difficulty. If the lesion is on the left side in a right-handed person, disturbances in speech are more likely to be present. Visual hallucinations and disturbances of vision of the hemianopic type are of the greatest value. This is because the visual fibers, in their course from the primary visual centers to the occipital lobe, make a loop around the posterior horn of the lateral ventricles. One cannot depend on pressure phenomena, such as a slow pulse. Frequently the only symptom observed in a temporosphenoidal abscess is a change in personality. Similar symptoms are obtained in frontal lesions. Usually,

lesions of the frontal lobe are not recognized until the motor area is impinged on with the appearance of jacksonian convulsions and hemiplegia on the opposite side.

I wish to emphasize here that there is no such thing as a higher psychic center in the frontal lobes. I believe that intellectual functions are the result of the activity of the entire brain, and while lesions of the frontal lobe give a disturbance of the psychic functions, similar symptoms result from tumors elsewhere.

As a rule, the diagnosis of lesions in the cerebellum does not offer as much difficulty as diagnosis of lesions in the temporosphenoidal lobes, but here again no clear-cut syndrome is to be expected. My experience has been that chronic abscesses are more likely to occur in the temporosphenoidal lobe, and that acute abscesses are more likely to occur in the cerebellum.

While it is generally acknowledged that the function of the cerebellum is equilibration and that its business consists of synergizing all movements of the body, nevertheless the diagnosis of cerebellar lesions is by no means easy. One reason for the difficulty of such diagnoses is that most physicians seem to consider that to make a proper cerebellar diagnosis it is necessary to have a disturbance of gait and station in all instances. Nothing is further removed from the facts, for there is functional localization in the cerebellum as well as in the cerebral cortex. It is obvious that if a patient has a lesion in the vermis there will be disturbance of the truncal movements only, but that if the lesion is limited to the lateral lobes, dyssynergia may be present only in the movements of an arm or leg.

### VESTIBULAR TESTS

Herein lie some of the fallacies arising from vestibular tests. The value of such tests rests on the accuracy of the knowledge of the course of the tracts leading from the vestibular nuclei in the medulla. Physicians have definite knowledge of the course of the fibers from the vestibular nuclei to the posterior longitudinal bundle, but I wish to emphasize that they do not have a definite knowledge of the course of the fibers from the vestibular nuclei to the cerebellum. So far, there has been practically no accurate pathologic check-up in any of the cases in which these tests have been used as an aid to diagnosis. It is obvious, for example, that the so-called falling or pelvic test cannot be present in tumors or lesions of the lateral lobes of the cerebellum, and therefore any observations made on the presence and absence of such reactions must necessarily be inaccurate.

On the other hand, there is no question that these tests are of clinical value. As the result of the work, principally in the Philadelphia school, there has grown a syndrome of the cerebellopontile angle, which is now

fairly well established. But it is not infallible. As an example of what can be accomplished by means of vestibular tests in suspected tumor of the brain, I wish to call attention to the recent paper of Grant and Fisher, in which they reported 116 verified intracranial lesions. Finally, I wish to emphasize that in every case of lesion of the brain, particularly in the posterior fossa, vestibular tests should be utilized as an aid to diagnosis, but the diagnosis should not be made on these tests alone.

### THE LABYRINTH

In recent years, in the literature on neuro-otology, the labyrinth has perhaps received most attention. It is considered by Sherrington to be a receptive organ capable of stimulation by change of position of the head. By it are elicited reflexes that excite different parts of the body, particularly the muscles of the neck. As Sherrington has pionted out, there is a resemblance between the labyrinthine receptors and the proprioceptors of the limbs, in that in both stimulation occurs chiefly through the reaction of the organism itself, and in that they both originate and maintain tonic reflexes in the skeletal muscles. Advantage has been taken of this theory by Magnus and de Kleijn, who have shown the relationship of tone to the labyrinth in decerebrate animals. The labyrinth controls the tonus of the muscles of the neck as well as of the extremities. Whereas each labyrinth may influence the tone of the extremities of both sides, the influence of the labyrinth on the neck musculature is unilateral. Rotation of the head causes constant changes in the muscle tone and posture. These observations I merely mention to point out the tendency of the recent literature.

Symptoms of disease of the labyrinth as well as of the central vestibular system are manifested through spontaneous symptoms and in certain anomalies in the clinical functional tests of the labyrinth.

Of the spontaneous symptoms, vertigo is, of course, the most common. There is no symptom more difficult to define on the part of the patient. One of the best descriptions is by Hughlings Jackson, who described vertigo as a sensation of motor origin, the result of a discord between the impressions that come from the labyrinth, the cerebellum, the muscles of the eyes and from other sources with which they coordinate or act in harmony. As the result of the discord of these impressions, the consciousness is affected with a distressing sensation known as vertigo.

It would be important if it were possible to differentiate organic from functional vertigo from the clinical descriptions of patients. To some extent this can be done, but mistakes are common. I shall discuss only three types of vertigo; first, that resulting from toxic disease; second, epileptic vertigo, and last, functional vertigo.

### TOXIC VERTIGO

In looking over my records of more than twenty-five years, I find that I have been consulted as often for dizziness as for any other symptom. Sometimes the dizziness is extreme. In many cases it has been of a distinctly toxic origin. In one instance, a physician, who is a nose, throat and ear specialist in a neighboring town, experienced a dizziness which was so extreme that he had to give up his practice. The vestibular tests indicated a cerebellar tumor. My examination did not verify this. Everything that could be thought of was tried, and as he was an ex-major in the service, the patient was looking forward to a life of invalidism under the supervision of the Veterans' Bureau. He was an excessive cigaret smoker. One day he developed a bad cold and was compelled to stop smoking for a few days. To his surprise, he noticed that he did not feel dizzy. From that time on he has not had an attack, although smoking a cigaret will always bring one on.

In another patient, a clergyman, the dizziness was finally removed by the excision of both tonsils and some bad teeth. In him also, the vestibular tests indicated the possibility of a cerebellar lesion. In a third patient, also a physician practicing in one of the Philadelphia suburbs, the dizziness finally ceased after colonic irrigations. Here also the vestibular tests indicated cerebellar tumor.

I could multiply these cases at length. I have learned from experience, however, to assume that in most labyrinthine involvements, the patients are toxic. I have had excellent results with such diagnoses.

### EPILEPTIC VERTIGO

One of the most difficult differential diagnoses to make is between aural vertigo and the minor types of epilepsy, a distinction that is not recognized as frequently as it should be. There may be only a feeling of turning or uncertainty or an actual sensation of rotation, which is either partial or complete, or there may be a sudden fall. Of course, aural vertigo can always be distinguished from the minor epileptic type by the fact that in epilepsy there is nearly always a history of major spasms. For many years I have never failed to obtain a history of minor spasms, especially the psychic type, in every patient who has epilepsy. This fact is not so generally recognized as it should be. The confusion arises in the fact that minor epileptic attacks often are accompanied by tinnitus, and that there might be only a slight giddiness without a complete loss of sensation.

Epilepsy and labyrinthine vertigo occasionally occur in the same patient. It must also be recognized that aural vertigo, as well as epilepsy, may occur during sleep.

### FUNCTIONAL VERTIGO

In my experience, dizziness is most commonly found in the nervous patient. Any one can bring on a feeling of vertigo by concentrating on the process of loss of balance and by calling up the recollections of giddiness, which are familiar to every one. Neurasthenic persons have this power in a still greater degree, and in them fear and thought of vertigo are sufficient to produce it. In these patients, the nature of the vertigo can sometimes be ascertained by the description of the patient and, of course, also by exclusion. For example, in a certain patient, a dentist, who feared that he had a cerebellar tumor, there was a feeling of swaying from side to side when he was performing an operation or reaching for an instrument, and yet if he touched an intervening object only slightly with the finger tip, this swaying would disappear. This patient played a good game of golf and never had the slightest dizziness when doing so. In this man, the fear of falling obtruded itself into his consciousness to such an extent that the sense of dizziness or the fear of it was always imminent. Dizziness is especially common in the traumatic neuroses when the head is injured. In practically all these cases, dizziness disappears with the settlement of litigation; but it cannot be said that the description furnished is characteristic any more than that the description is such as to put one on guard against the possibility that the dizziness is labyrinthine in origin.

Among the unusual manifestations in epidemic encephalitis is the involvement of the labyrinth. This was called attention to by Barré and Reys, in 1921. Since then a great many cases have been reported. The usual symptoms of encephalitis, which consist of lethargy, oculomotor paralysis, twitching, pains, etc., may be present. Frequently, however, the labyrinthine symptoms predominate or may be present alone, and in such cases the history is usually of a sudden attack of vertigo which is not continuous, and which compels the patient to cease his occupation. This dizziness is accompanied by an uncertain gait, nausea and vomiting.

It is now known that encephalitis is a chronic process, and that from the pathologic standpoint it is best to speak of these cases as chronic encephalitis rather than postencephalitic complications. Labyrinthine symptoms may come on in the beginning or in the course of the disease. The pathologic changes in the few cases reported have been found in

the vestibular nuclei in the medulla. It can readily be seen, when the anatomic connections of these nuclei are considered, that ocular disturbances are not uncommon.

### TOXIC MANIFESTATIONS

Mention has already been made of the influence of toxins on the optic nerve due to complications in the sinus. What is not generally recognized is that general toxemias may similarly influence not only the optic nerve but also the eighth nerve. Such diseases as syphilis, for example, have a predilection for the eighth nerve. In fact, the eighth nerve and the optic nerve are probably affected the earliest, involvement of the vestibular nerve causing a change in vestibular reaction.

### FUNCTIONAL CONDITIONS IN THE EAR, NOSE AND THROAT

During the war hysterical deafness and aphonia were common, but these conditions are rarely found in private practice, except in litigation cases. Mention has already been made of the frequency of dizziness and the fear that this symptom engenders in the minds of patients that they have some kind of a tumor of the brain. Instead of deafness, hyperacuity of hearing may be present. Hyperosmia or dysfunction of the sense of smell is not infrequently an hysterical phenomenon. All neurologists have had experiences in which patients have imagined that they have various objects in their throats. One of my patients, for example, constantly imagined that she had a cherry in her throat, although repeated examinations and assurances were of no value.

Throat neuroses are more common, especially in singers. I have had many patients who swallow on singing. A typical history is that of a prominent singer who, while in the midst of a public performance, suddenly swallowed. The fear of the consequences of the repetition of such an act immediately took possession of her, and from that time she was unable to sing because of swallowing.

I remember some years ago a singer of considerable reputation who was a swallower. In my attempt to reeducate her, I had occasion to be present during a singing lession. While there she began to sing well, but noticed that her teacher was also swallowing. Immediately she began to swallow, and in a short time I followed and we were all swallowing as hard and fast as we could. This is only an illustration of the fact that hysterical symptoms are referred to the function of greatest importance to the patient.

Finally, I wish to refer briefly to persons who are constantly coughing and clearing their throats, particularly if they are attending a musical

performance, such as a symphony orchestra concert. Such persons get the habit of clearing their throats and coughing, not because they have to but because they are not paying attention to the music, for if one really pays attention, movement is impossible.

An audience at a moving picture show is quiet, and excellent attention is obtained. In the so-called eye and ear show, in which both hearing and vision are necessary, the attention is even better, for here two senses are employed in gaining attention. However it is an entirely different matter to attend a concert by a symphony orchestra; here, only the auditory attention is called on. The truth is that in almost every one visual sense is better developed than auditory, and that auditory sense is on a higher level than visual. That is the real reason for the popularity of the movies and for the noise in orchestra performances.

# RELATION OF ORAL ARTICULATIVE MOVEMENTS OF SPEECH AND OF EXTRINSIC LARYNGEAL MUSCULATURE IN GENERAL TO FUNCTION OF VOCAL CORD*

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The production of speech has been conceived as involving the employment of certain areas and certain kinds of muscular action. The first and basal activity is that of the chest; the second, that of opening and closing of the vocal cords; third, the articulative movements of the organs in the mouth, and the fourth, the movements of the larynx as a whole and of its adjacent structures. The terms movements of the chest, intrinsic laryngeal movements, articulative movements and extrinsic laryngeal movements have been employed. Each of these four departments of muscular action has, for the most part, been conceived as a physiologic entity, although cooperating for a common purpose. Action of the chest to produce speech is well understood; the laryngoscope has made clear the meaning of all ordinary gross movements within the larynx, and most of the action of the organs in the mouth can be directly observed and analyzed; but the movements of the laryngeal body itself and of its adjacent structures have not lent themselves readily to study, and have remained unexplained. Moreover, movements within the larynx and within the mouth are relatively simple and easy of understanding, while those of the laryngeal body and of the closely related hyoid bone are more complex, obscure and seemingly vague of purpose. As a matter of fact, the entire region of laryngeal and oral action for the production of speech appears to the close observer to be intimately interwoven muscularly, and not to admit of functional separation. The problem of clarifying the knowledge of the function of the peripheral structures in talking, calls for an understanding of the movements of the laryngeal body and of the hyoid bone in the production of speech and of their relation to the articulative movemens and to vocal cord approximation. The habitual limited intrinsic point of view concerning the function of the larynx, together with an equally narrow articulative study of the movements of the mouth, cannot clarify the knowledge of the function of the peripheral structures in talking. Continuation of this narrow conception of study means necessarily the abandonment of all hope of

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ever completely understanding the laryngeal function, either normal or abnormal. Appreciation of the physiologic and psychologic phenomena of normal talking, as well as of certain disorders of speech, including stammering, dysphonia spastica, the peculiarly disturbed voices of the deafened and other defects, as well as of certain problems of the artistic employment of voice and speech, necessarily await advancement in the present knowledge of the function of the larynx in speech.

In the present study I attempt to approach the laryngeal activities of speech on the peripheral side in its entirety. This study consists largely of an effort to add to existing knowledge of the significance of the extrinsic musculature of the larynx, especially in its relation to the action of the vocal cords and in general to throw light on the remarkable cooperation of the extrinsic and intrinsic muscles in the production of speech. In this endeavor, my study introduces a manner of investigation that is new to this field and that possesses undoubted usefulness.

No new investigations in anatomy will be offered. The anatomy of this study is that of the current anatomic textbooks. But as there is need to refresh the memory on anatomy and as it is my purpose to endeavor to throw new physiologic light on old anatomic knowledge, new interpretations of anatomic facts will be in order.

## ANATOMY AND PHYSIOLOGY

The framework, as well as the lumen, of the trachea is immediately continued by the framework and lumen of the larynx. Being closely, almost immovably, joined to the uppermost tracheal cartilaginous ring, the cricoid cartilage, which constitutes the fixed support of the other cartilages of the larynx, is but a modified tracheal segment. But at this point, close anatomic resemblance of the larynx to the trachea ceases. Here begins a most remarkable anatomic and physiologic mechanism that extends far beyond the larynx itself.

The extraordinary part of the mechanism of the larynx lies not in the cricoid cartilage or in the arytenoids or even in the vocal cords themselves, but rather in the manner in which the thyroid cartilage and the thyro-arytenoid muscles transmit the movements of the extrinsic mechanism of the larynx to the vocal cords. The arytenoids, with their attached movable vocal shelves, as well as the principles of their gross movements, are understandable on ordinary mechanical grounds. They could even be accurately duplicated in principle by a mechanical device. But to comprehend the mechanism and purpose of the thyroid cartilage in its completeness is a much more complicated and difficult matter. Moreover, the movements of this cartilage stand, as it were, as a guide to the significance of the extrinsic musculature in its influence on the action of the vocal cords.

The trachea, larynx, hyoid bone and lower jaw may be looked on as a secondary solid bodily framework, which, together with the spinal column and the skull—the main solid supporting structures of the body—makes possible the building of the pharynx, the cavity of the mouth and its chief organ, the tongue. The trachea and cricoid cartilage together constitute the lower, relatively immobile section of the secondary framework, and the arytenoids, thyroid cartilage, hyoid bone and lower jaw constitute the upper and mobile section (fig. 1).

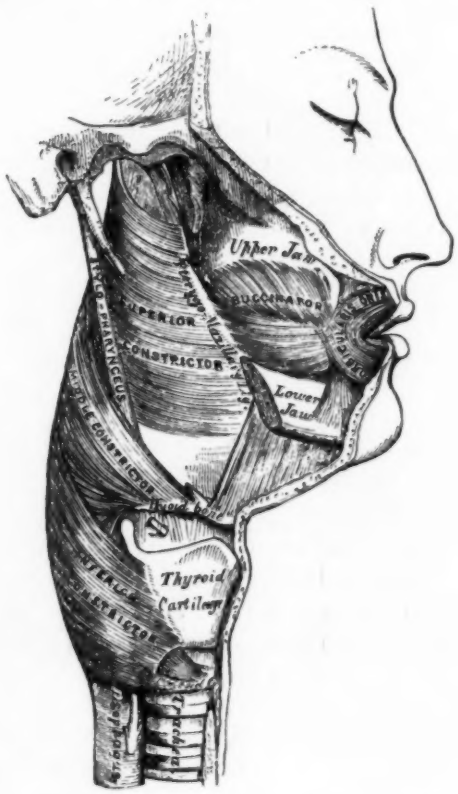


Fig. 1.—The powerful constrictor muscles in their relation to the laryngeal cartilages and hyoid bone. (From Gray's "Anatomy.")

The complex muscular system which controls this upper, movable section is divisible into two distinct subsystems: first, that which is constituted by the muscles attached only to laryngeal cartilages, the intrinsic laryngeal system; and second, that which is made up of muscles attached only at one end, or not at all, to the larynx, but which exert an influence more or less important in the adjustments of the vocal cords. Altogether, these muscles constitute the so-called extrinsic musculature of the larynx.

The intrinsic muscles, so far as they are related to vocal cord adjustment, perform all the larger movements of the vocal cords;[1] in addition, through the cricothyroids they help to move and to control the action of the thyroid cartilage on the cricoid.

The extrinsic muscles, the function of which is so much more difficult to understand, from the point of view of this study, include all muscles that are not intrinsic but that are in action to produce speech. They may be classified as follows (figs. 1, 2, 3):

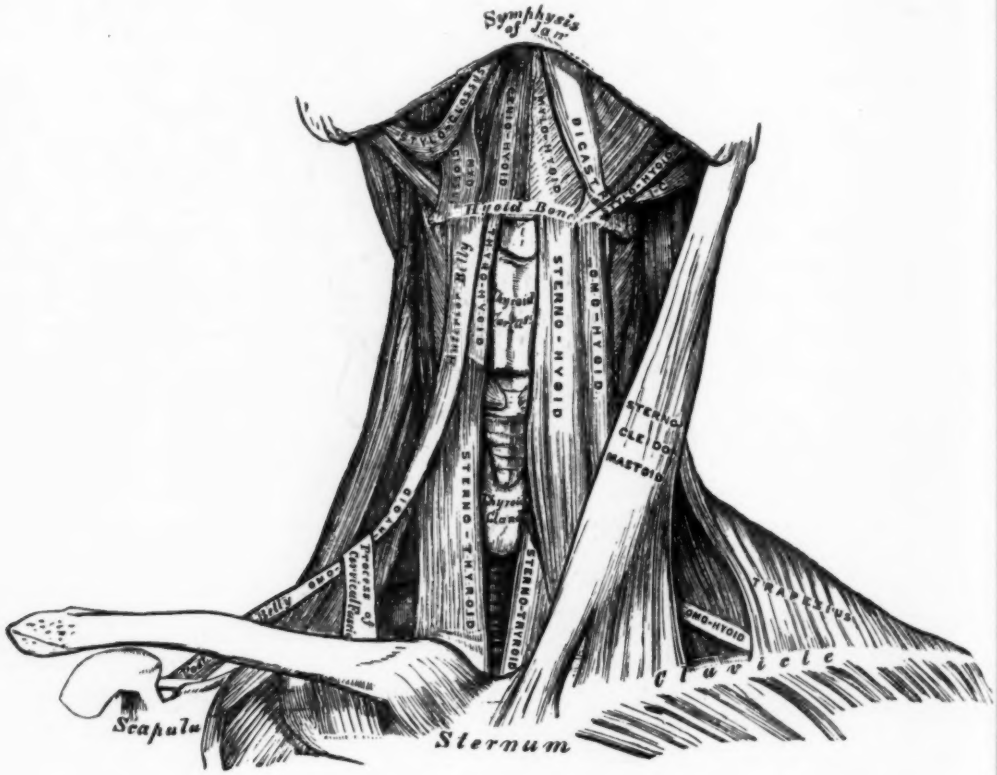


Fig. 2.—The complicated system of hyoid and thyroid muscles, all necessarily in action for the proper placement of the thyroid cartilage on the cricoid in the production of any vocal sound. (From Gray's "Anatomy.")

1. The muscles that serve primarily to move, and to control the relations of the thyroid cartilage on the (nearly) fixed cricoid: the thyrohyoids and the sternothyroids, the palatopharyngei and the stylopharyngei.

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1. Kenyon, Elmer L.: Significance of the Extrinsic Musculature of the Larynx, J. A. M. A. **79**:428 (Aug. 5) 1922.

2. The muscles that control the movements of the hyoid bone: the thyrohyoids, chiefly determining the relations of hyoid bone and thyroid cartilage; the sternohyoids and omohyoids, controlling the general movement downward; the muscles that determine the relations of the hyoid bone to the lower jaw and tongue—the mylohyoids, geniohyoids, geniohypoglossi, digastric, hyoglossi; the muscles that immediately determine

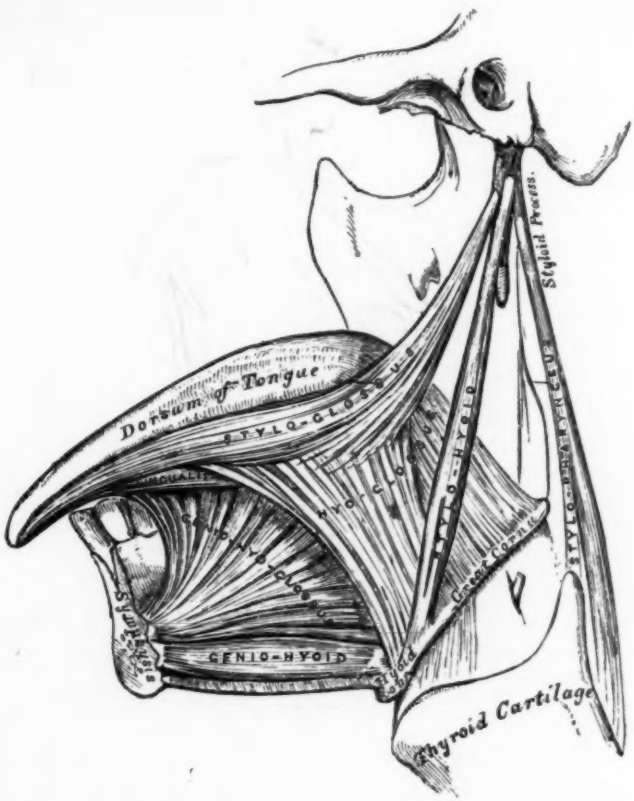


Fig. 3.—The hyoid bone is intimately involved anatomically and functionally, above with the tongue and below with the thyroid cartilage; the drawing shows the involvement of certain muscles of the styloid process in this intimate relationship. (From Gray's "Anatomy.")

the relation of the hyoid bone to the skull—the stylohyoid and the digastric; and the middle constrictor muscle, which determines the relation of the hyoid bone to the spinal column.

3. The muscles that attach the tongue to the skull; the styloglossi and the palatoglossi.

4. The constrictor muscles, which create the movable side walls of the pharynx, determine the relations of the larynx and the hyoid bone to the spinal column and delimit the movements of the thyroid cartilage and the hyoid bone.

5. The muscles that raise the lower jaw on the skull: the temporal, masseter and pterygoid.

The last group, the muscles that raise the lower jaw, are much more concerned with their direct function, that of closing the mouth

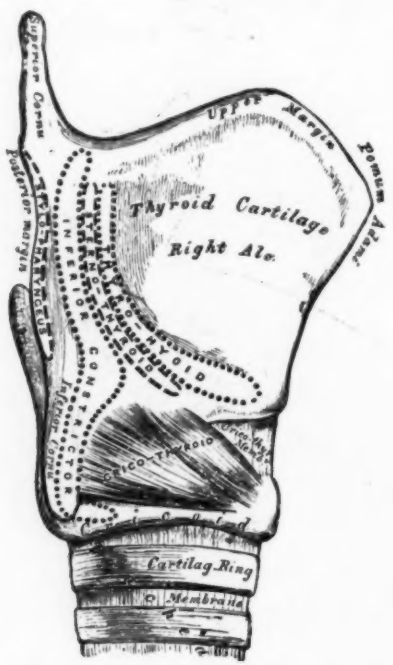


Fig. 4.—Side view of the thyroid and cricoid cartilage. All the muscles of the extrinsic system that are inserted into the larynx are attached to the movable thyroid cartilage, except one small end of the inferior constrictor; this small end is attached to the relatively fixed cricoid cartilage. (From Gray's "Anatomy.")

and of mastication, than with the movements of the vocal cords. However, since the hyoid bone directly, as well as by way of the tongue indirectly, is suspended from the lower jaw, no movement of that structure can occur without affecting in some degree the position of the hyoid bone, and through it also the position of the thyroid cartilage.

Of all the muscles of the extrinsic system, five pairs are attached to the larynx itself: the palatopharyngei, the thyrohyoids, the sternothyroids, the stylopharyngei and the inferior constrictors. Of these five

pairs of muscles, only one pair, the inferior constrictors, is attached to the cricoid cartilage, and even these have a large area of attachment to the thyroid. The other four pairs are attached to the larynx only by way of the thyroid cartilage. Thus the extrinsic system applies its influence on the larynx almost entirely by way of the movable thyroid cartilage (fig. 4).

The relations between the thyroid and the cricoid cartilage are altered only through their one direct movable means of contact, the cricothyroid joint. The indirect movable contact, through the vocal cords and the arytenoids, does not seem to affect the relative position of the two great cartilages. The relations of these two movable attach-

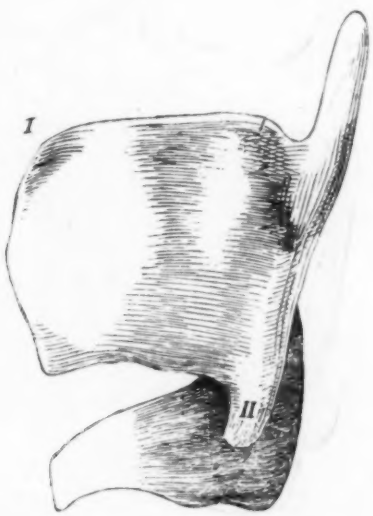


Fig. 5.—*I* denotes the spot on the thyroid cartilage on which the finger is placed for study of the movements of this cartilage when the larynx is in action; *II* is the cricothyroid joint. (From Gutzmann's "Physiologie der Stimme und Sprache.")

ments of the thyroid to the cricoid cartilage are such that any movement of the thyroid on the cricothyroid joint either increases or decreases the distance between the two insertions of the vocal bands, and to a small degree alters the vertical location of their insertion into the thyroid. On the other hand, when the points of attachment of the vocal cords in relation to each other are altered by movement of the thyroid cartilage on the cricoid, not only are the vocal cords either stretched or relaxed, but also the relations of the origins and the insertions of the thyro-arytenoid muscles to each other and to the vocal ligaments must thereby be altered. The influence of the movements of the thyro-arytenoid muscles on the adjustments of the vocal cords still remains to be worked

out in detail. It is known that the lengthening and shortening of the distance between the points of insertion of the vocal cords by movement of the thyroid cartilage on the cricoid cartilage is an important factor in the physiology of the mechanism of the pitch of the voice, but that the influence of the thyroid muscular mechanism on the action of the vocal cords for vocal purposes is more complex and subtle than the mere stretching of the vocal cords, is at any rate possible (figs. 5 and 6).

The thyrohyoid muscles determine chiefly and directly the movable relation of the thyroid cartilage to the hyoid bone. The sternothyroid muscles accomplish the same function with relation to the sternum. The inferior constrictors determine the relation of the thyroid cartilage

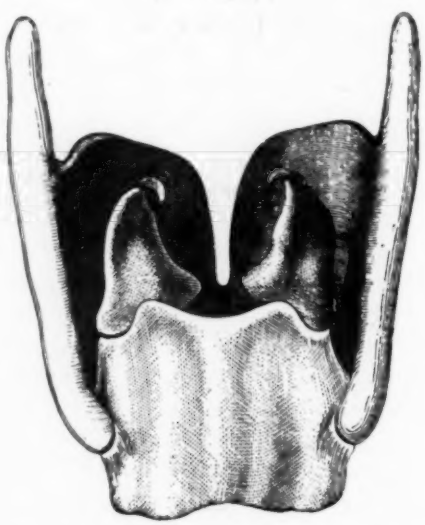

Fig. 6.—View of the cricothyroid joints from behind. The cricoid cartilage is essentially a ring of the trachea, and is relatively fixed. The movable thyroid cartilage is the key to the purpose of the movements of the extrinsic musculature. (From Gutzmann's "Physiologie der Stimme und Sprache.")

to the spinal column as far as these muscles are concerned, as well as its relation to the cricoid cartilage. All movements of the thyroid on the cricoid are determined by these and other extrinsic muscles in cooperation with the intrinsic cricothyroids. When the position of the hyoid bone is altered, which occurs with infinite frequency in talking, the thyroid muscles above must accommodate themselves to the effect of the hyoid movement in such a manner as to bring about the desired adaptation to the vocal cords. This implies also a most delicate cooperation on the part of the thyro-arytenoid muscles.

The hyoid bone is primarily an organ of the mouth. First, it forms the posterior support of the mylohyoid muscles, which are attached

to the lower jaw, and together they constitute the muscular floor of the oral cavity. Second, the hyoid bone, with the lower jaw, serves as the solid support for the extrinsic muscles of the tongue, which is essentially an outgrowth from the hyoid bone. Third, movements of the muscles of the tongue, except those of its very tip, affect the location of this carefully balanced bone, which is also intimately coordinated with the thyroid cartilage. All movements of the lower jaw and of the body of the tongue affect the location of the hyoid bone, up or down or anteroposteriorly. This effect on the hyoid must alter its relation to the thyroid cartilage and the relation of the latter to the cricoid cartilage. In all such speculation, however, one should not lose sight of the possible simultaneous counterbalancing, in whole or in part, of the action of one muscle by that of other muscles.

### SIGNIFICANCE OF LARYNGEAL MUSCULATURE

The most significant fact concerning this entire system of about sixty muscles, intrinsic and extrinsic, is that it serves to unite trachea, larynx, pharynx, hyoid bone, lower jaw and tongue into one closely interrelated, complex musculature mechanism. Another extraordinary fact, hardly less remarkable than the first, is the predominance of the movable thyroid cartilage in the system. As has been stated, all extrinsic muscles attached to the larynx, with one exception, are inserted entirely into the thyroid. Since any movement of the thyroid cartilage on the cricoid necessarily affects the alinement of the vocal bands, all movements of this complex extrinsic musculature, so far as the larynx is concerned, are evidently directed in purpose to the vocal cords themselves. In view of the fact, however, that the vocal cords constitute the essential organ of the larynx, their importance to this extraordinary system of muscles is not surprising.

An understanding of all this remarkable complexity of organs and muscles becomes possible only by realizing that they act together as a complex whole to constitute certain bodily spaces and organs of the body, and to accomplish certain functions. It must also be realized that these spaces, organs and functions are primarily intended for animal purposes on which certain physiologic processes of life depend. When Nature conceived of ending the esophagus and trachea at their exit into the outer air by means of a common space and common organs, the vital problem to be solved with reference to these common organs of exit was the avoidance of interference between the two functions, one related to breathing and the other to eating. Provision for the protection of the lungs against food passing in either direction through the common pharyngeal space must be made. In order to carry on such pulmonary functions as coughing, sneezing and compression of the abdomen, a special air control at the exit of the lungs must be at hand.

The larynx constitutes this peripheral valvular end-organ of the lungs, and of course is absolutely essential to existence, whether in the lower animals or in man. In respect to the functions related to the lungs (such as coughing and compression of the abdomen), the action of the larynx is direct, positive and essential to the function; with respect to

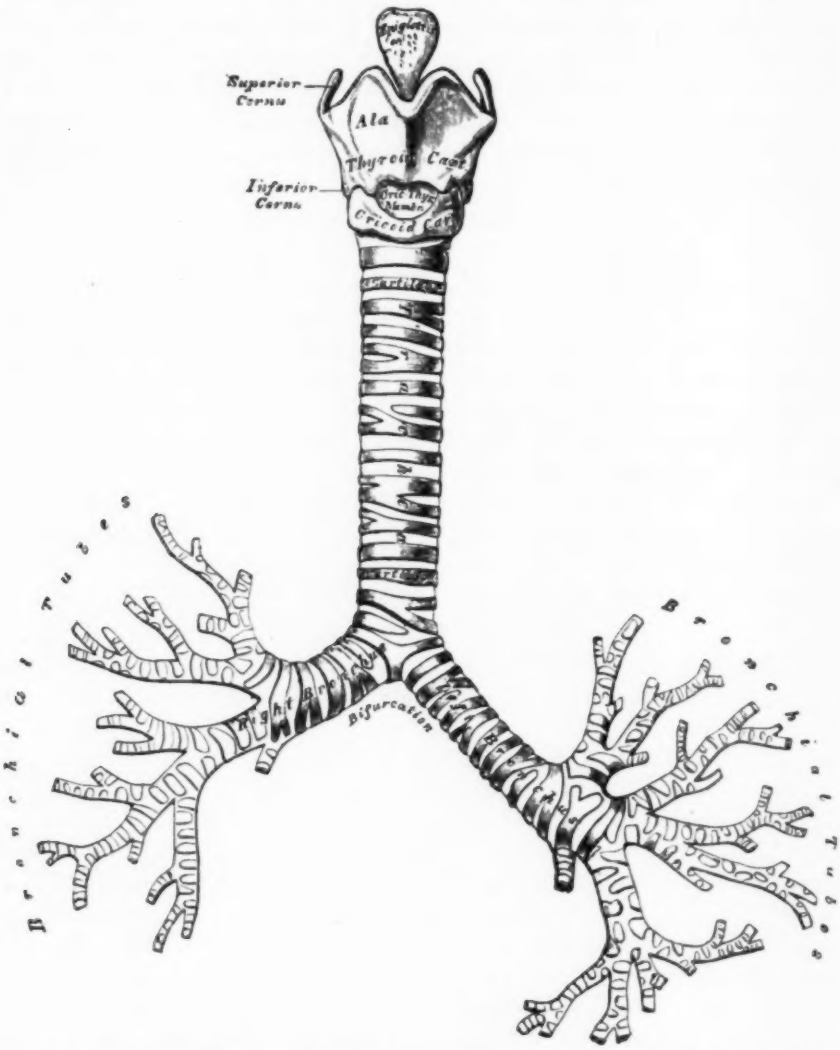


Fig. 7.—The larynx as the valvular end-organ of the lungs, intended primarily for animal functions. (From Gray's "Anatomy.")

the functions related to the stomach (such as swallowing and vomiting), its action is secondary and protective against accident to the lungs, the larynx under these circumstances being a bodyguard of the vital central organ of breathing (fig. 7).

The tendency of students of the function of speech has been to look on the larynx as a distinctive, independently acting organ, peculiar to man and intended exclusively for talking. But in discussing the activities of the larynx, hyoid bone and tongue and their musculature, both intrinsic and extrinsic, for purposes of speech, one must never lose sight of their fundamental uses as organs of life itself. Talking is but a superimposed, conscious, highly intelligent modification in the use of these same organs, and probably of the same cerebral machinery. Only through keeping one's feet on the ground of fundamental animal physiology, can one hope to move forward to a complete understanding of the action of the physiologic mechanism of talking, either peripheral or central.

To impress firmly the idea already expressed that the musculature in which the larynx is involved constitutes a complex but closely coordinated and inseparable muscular system, let me add that in all animal functions, as well as in the intellectual function of talking, in both of which the coaptation of the vocal cords is essential, the intrinsic and extrinsic muscles act as one united system. Indeed, whether the function be animal or mental, psychoneuromuscular mechanism for controlling the movements of the vocal cords does not exist, except through the combined action of the intrinsic and extrinsic muscles of the larynx. In other words, for any functional purpose, the intrinsic muscles cannot act alone to coapt the vocal cords, but must act in cooperation with the extrinsic muscles, which necessarily are also in action. Nature does not provide any other psychoneurologic machinery.

In attempting to explain so important a fact, one must give predominant weight to the primary animal functions of the larynx. These are not only basal in the life of the animal, and therefore present at birth, as compared with the acquired secondary intellectual function of talking, but they are also actually life-preserving. All of them are apparently performed with complete closure of the vocal cords, absolute air-proof closure.

## EFFECT OF EXTRINSIC MUSCULATURE ON ADJUSTMENTS OF THE VOCAL CORD

The intrinsic laryngeal musculature, as I have said, accomplishes all the gross movements of the vocal cords that laryngologists study so closely in the laryngeal mirror.[2] Each arytenoid cartilage is turned on the cricoid joint by its own adductive and abductive musculature; and coaptation of the arytenoid cartilages themselves is produced in adduction by their own intrinsic interarytenoideus muscle. The extrinsic musculature plays no immediate part in these gross movements.

2. Kenyon, Elmer L.: A Broader Approach to Unsolved Problems in Laryngeal Action, Laryngoscope **34**:901, 1924.

It has long been presumed that one purpose of the action of the extrinsic musculature, as a necessary preliminary to accurate movement of the intrinsic muscles, is to steady the wabbly larynx. But evidence is gradually accumulating that also places the influence of the extrinsic musculature directly on adaptation of the vocal cords, first, for purposes of alteration of the vocal pitch, and, second, possibly, for determining vocal quality. The only machinery provided for so influencing the adaptation of the vocal cords by the extrinsic musculature is the movement of the thyroid cartilage on the cricoid; a means is thus provided for altering the relative distance and position of the two ends of the vocal bands. This action, as has been said, presumably also affects cooperative modifications in the action of the thyro-arytenoid muscles. The entire purpose seems to be to render the finer adjustments of the vocal cords intelligently in accord with the detailed needs of speech and song.

### EXTRINSIC MUSCULATURE WITH REFERENCE TO PITCH

For many years physicians have adopted the conception that the stretching of the vocal cords for elevating the pitch of the voice was brought about by a tipping downward of the thyroid cartilage on the cricoid. This conception presumably arose from the fact that the only intrinsic muscles that serve to produce movement between these cartilages, the cricothyroid muscles, affect a movement of the thyroid cartilage downward. As physicians had no knowledge of the unity of action of the intrinsic and extrinsic musculature and, therefore, based their conception of laryngeal action solely on the possibilities in the action of the intrinsic muscles, the foregoing conception of the use of the cricothyroid muscles was logically arrived at from this narrow point of view.

In 1886, John Howard, a teacher of singing in Boston, published a book [3] in which he made an elaborate anatomicophysiologic study of the separate action of each muscle and of each group of muscles, both intrinsic and extrinsic, and of the presumed influence of each muscle and each group of muscles on the singing voice. The study was elaborate, detailed, intelligent, painstaking and useful. It supplemented well other careful studies of the extrinsic musculature made about that time, particularly those of von Meyer [4] and, earlier, of Brücke.[5] Nevertheless, the methods employed in Howard's studies, even in spite of their thoroughness and even though they concerned the extrinsic as well as the intrinsic

3. Howard, John: Physiology of Artistic Singing, Boston, published by the author, 1886.

4. Von Meyer, George Hermann: The Organs of Speech and their Application in the Formation of Articulate Sounds, New York, D. Appleton & Company, 1884.

5. Brücke: Grundzüge der Physiologie und Systematik der Sprachlaute, Vienna, 1856.

muscles, were incorrect in principle and incapable of arriving at a true understanding of the combined action of the extrinsic and intrinsic muscles on the function of the vocal cords. Howard studied the origin and insertion of each muscle, and then attempted to reason out what would happen when certain muscles or groups of muscles were in action in certain ways. But the origins or the insertions, or both, of a large proportion of the muscles involved are attached to movable organs which, at the time of the action of the attached muscles, are themselves under-

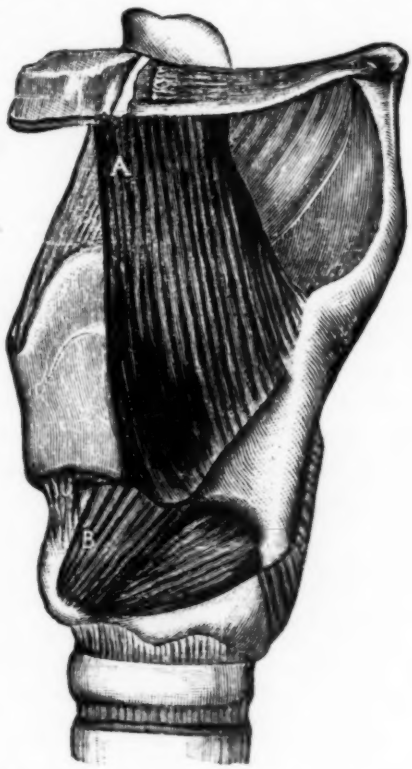


Fig. 8.—Showing how the thyrohyoid muscle must counteract the effect of the cricothyroids when both are in action. *A*, thryohyoid muscle; *B*, cricothyroid muscle. (From Luschka as shown in Howard's "Physiology of Artistic Singing.")

going changes of position; and, while all the muscles of the system are probably in action at the same time, any muscle or group of muscles might be acting at widely different degrees of intensity at different times. In view of these complexities of muscular possibilities, any attempt at drawing conclusions by the study of single muscles or groups of muscles while acting in a supposedly definite manner, is almost certain to be more or less erroneous. In order to understand the action of such a

complex group of cooperating muscles, one must aim to learn not what these muscles might do, but what they actually accomplish by cooperation.

In order to prove that this method of study may lead to the extreme of error, I shall briefly review Howard's conception of the action of the laryngeal musculature for stretching the vocal cords in order to increase the vocal pitch. As I have already stated, working from a knowledge of the intrinsic muscles alone, laryngologists had already concluded that for this function the action of the thyroid cartilage moving on the cricoid was downward. Von Meyer, although familiar with the extrinsic musculature, had reached a similar conclusion. Whether or not Howard was influenced by the laryngologists or by von Meyer is not apparent. Be that as it may, Howard writes: "The most essential matter is this: that the combined up-pulling and down-pulling muscles must tilt the thyroid cartilage downward and forward, for the main object is to stretch the vocal shelves. This movement is called tilting." Following this premature conclusion as to how the thyroid cartilage ought to move for elevation of pitch, the author devotes much space to an elaborate and overingenious demonstration to show how, by a combined action of certain up-pulling hyoid muscles, especially the palatopharyngei, with the down-pulling sternohyoids, combined with the cricothyroids, the thyroid cartilage is tilted downward in order to stretch the vocal shelves for the elevation of the pitch of the voice. That this position of the laryngologists and of Howard with reference to the physiology of the production of pitch was exactly the reverse of the truth will be shown [6] directly (fig. 9).

6. Howard's effort to demonstrate the action of the laryngeal muscles for elevation of the vocal pitch has a peculiar historical importance that demonstrates how one fundamental error may continue its false influence far beyond the immediate occasion for its expression. My late colleague, Dr. G. Hudson Makuen, of Philadelphia, an able laryngologist and student of the vocal function, was a close student and strong admirer of Howard. He accepted the demonstration of that author as correctly explaining the muscular mechanism of the elevation of pitch. When the subject of extracapsular enucleation of the tonsil came under discussion, Makuen, as will be recalled by all who passed through those strenuous convention discussions, strongly opposed such a procedure as a routine measure. His opposition was based directly on the importance that Howard gave to the action of the palatopharyngeus, the posterior pillar muscle, in production of pitch. Makuen said: "If you enucleate the tonsil extracapsularly, the danger of injury to the palatopharyngeus muscle will be very great [which has proved only too true], and if you seriously injure that muscle the mechanism for the production of musical pitch must be seriously impaired." (Makuen, G. Hudson: Relation of the Tonsil Operation to the Soft Palate and Voice, Laryngol. A. 1911; The Relation of the Lymphoid Tissue in the Upper Respiratory Tract to the Voice, Therap. Gaz., Feb. 15, 1915.) Makuen's personal work with tonsils was always done with the saving of the palatopharyngeus muscle as one of his chief cares. But history has shown that extracapsular enucleation of the tonsils, even when the posterior pillars have been injured, has had no appreciable influence on the mechanism of the production of pitch. While preservation of the posterior pillars will always be one of the most important requirements of good tonsillectomy, it is for a definite reason other than that related to the function of pitch.

## ACTUAL MOVEMENTS OF THE THYROID CARTILAGE IN PHYSIOLOGIC ACTION

The only possible way in which the action of a group of muscles so intimately and intelligently cooperative may be determined is by observation of how they act while performing physiologic functions. If von Meyer or Howard or Makuen had realized how simple it was to observe the actual movements of the thyroid cartilage, they would have been able to lead the laryngologists out of, instead of deeper into, a fundamental physiologic error.

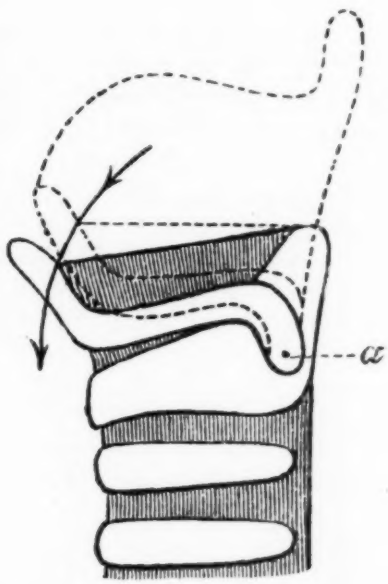


Fig. 9.—Von Meyer's diagram (1886) to show his conception of the physiology of stretching the vocal cords. The following is von Meyer's (Von Meyer, G. H.: The Organs of Speech and their Application in the Formation of Articulate Sounds, New York, D. Appleton & Company, 1884, p. 44) own description of the drawing; "To show that the depression, without the advancement, of the thyroid cartilage must cause the tension of the vocal cords. Position of the thyroid cartilage when at rest indicated by dotted lines; also that of the vocal chord. The continuous line shows the arc described by the thyroid cartilage, and also the vocal cord, when depressed. The arrow indicates the path of the point of attachment of the vocal chord with the thyroid cartilage upon the pivot *a*." The present article reveals the error of this conception of stretching the vocal cords.

Some years ago I realized vaguely the importance of the extrinsic laryngeal musculature to the production of speech, and I set out to observe systematically, under the varying conditions of speech, both normal and abnormal, the manner in which the thyroid cartilage, the

hyoid bone and related structures actually performed.[7] This study, while as yet hardly more than definitely begun, has already proved itself more than worth while.[8]

The thyroid cartilage is easily palpated in most men; the hyoid bone can be palpated, but with greater difficulty. In many women and in some children the difficulties are not great, but in other women and in most children intelligent palpation, while possible, requires much care and considerable experience. The ball of the first finger is placed steadily on the projecting upper part of the thyroid cartilage, the Adam's apple, during the act of talking, and its movements, which are chiefly in a vertical direction, are noted. The resting position of the cartilage constitutes the basal position from which the movement is studied. Working toward a standardized procedure, in this study of a particular patient I always ask him to count slowly and distinctly from 1 to 10, and then to enunciate slowly and clearly the following vowels: "e" as in "even," "a" as in "apes," "ah" as in "are," "aw" as in awed," "o" as in "over" and "oo" as in "oozing." In addition, I study the actual speech of the person in this manner. If both the thyroid cartilage and the cricoid (or the upper rings of the trachea) are palpated at the same time, one may learn to a considerable degree whether the movements of the thyroid represent chiefly an upward pulling of the trachea or a movement of the thyroid cartilage on its cricothyroid joint, for the relation of the extrinsic muscles is so close and intelligent that almost any possible cooperative effect may be superinduced. In these studies I have also kept in mind a mental picture of the position of the organs of the mouth during the production of each elemental sound (fig. 10).

By thus palpating the external thyroid region, I have learned the following facts concerning certain physiologic functions:

1. Action of the vocal cords, whether for animal or vocal functions, is always accompanied by extensive movement of the extrinsic musculature.

2. In all animal functions the thyroid cartilage is drawn up against the hyoid bone, and both thyroid and hyoid are drawn more or less tensely upward against the base of the tongue. The trachea and the larynx are moved up en masse in these functions. What effect is produced on the vocal cords themselves by this strong upward pulling of the trachea, thyroid cartilage and hyoid bone has not yet been determined.

3. In normal talking the thyroid cartilage moves with ease and freedom through a short range above and below its position when at rest.

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7. I have recently learned that a similar study, though apparently much less systematic and complete, must have been made years ago. Certain facts resulting from such study are mentioned in Brown, Lennox and Behnke, Emil: Voice, Song and Speech, New York, G. P. Putnam's Sons, 1883, p. 68.

8. Footnotes 4 and 5.

That is true also for singing, but with a more extensive and varied range of movement, dependent on a more frequent change, as well as on a wider range, of pitch than for talking. The trachea partakes but little in this movement.

4. For the production of the elemental sounds of the English language, each separate principle of articulative oral movement for the production of sound seems to be accompanied by an alteration in the position of the thyroid cartilage. For example, each vowel sound seems to have its own thyrocricoid position. This simultaneous reaction of the articulative movements of the mouth on the action of the thyroid

Fig. 10.—The manner of clinical study of the movements of the thyroid cartilage. While the patient is talking, the first finger, usually of the right hand, is placed on or against the tip of the thyroid cartilage (Pomum Adami). When it is desired to study also the movements of the trachea and cricoid, the thumb and second finger may be placed on these structures, as shown in the illustration.

cartilage in the production of the elemental sounds of the language demonstrates the existence of an immediate relationship between the articulative molds in the mouth, which determine largely the individual elemental sounds, and the simultaneous action of the vocal cords. The old conception, held by physiologists as well as by vocal teachers, that in the production of speech the vocal cords produce the voice, and that, as a distinct procedure, the organs of the mouth by their articulative movements shape the voice into speech sounds, must be definitely modified.

Consideration of the significance of the alteration in the position of the thyroid cartilage with each elemental sound of speech and the consequent presumable effect on the adjustment of the vocal cords, gives rise to the following theories: First, such a readjustment of the thyroid cartilage might be related only to the difference in pitch between individual elemental sounds. Second, such adjustments of the thyroid cartilage might be necessary (in view of the effect of articulative movements of the tongue and lower jaw on the position of the hyoid bone, and consequently on the thyroid cartilage) to retain the vocal cords always in the

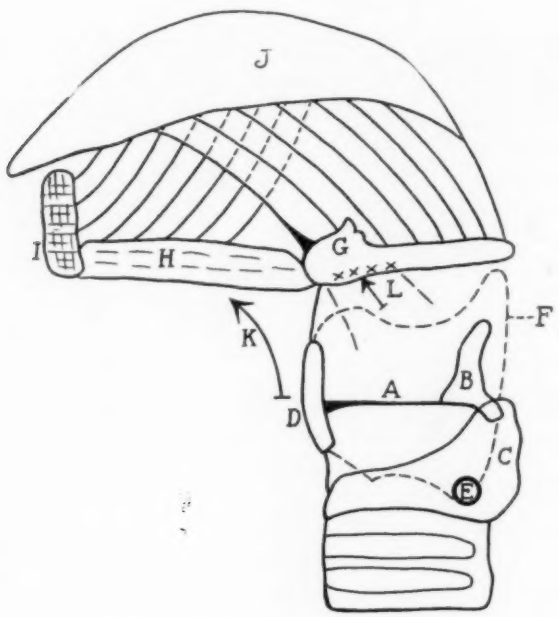


Fig. 11.—Stretching the vocal cords for elevation of vocal pitch, as determined by laryngeal palpation. *a*, vocal cord; *b*, arytenoid cartilage; *c*, cricoid cartilage; *d*, anterior wall of the thyroid cartilage; *e*, cricothyroid joint; *f*, outline of thyroid cartilage; *g*, hyoid bone; *h*, mylohyoid muscle; *i*, symphysis of lower jaw; *j*, body of tongue; *k*, direction of pull in stretching vocal cords; *l*, direction of pull of thyrohyoid muscle. The tilting of the thyroid cartilage on the thyroid is upward, not downward. Compare this diagram with figure 9.

same manner of adjustment. Third, each principle of the production of vocal sound might demand for its accomplishment a variation in the finer details of vocal cord approximation. Thus, one can now conceive of the production of voice at the vocal cords as occurring only in connection with a definite position of the organs in the mouth for each oral principle of the modification of sound. Speech and voice are not separate entities, as has heretofore been supposed. When any sound

of speech is produced, the primary act seems to be the creation of an articulative position by the organs in the mouth; with this position as a fixed basis, the extrinsic and intrinsic musculature seems to adapt itself for the proper adjustment of the vocal bands.

Each elemental sound of speech is naturally produced on its own peculiar pitch plane. It now becomes evident that this distinctiveness of pitch for each sound is dependent chiefly on the particular position of the hyoid bone (and consequently on that of the thyroid cartilage) for each sound, and that the elevation of the hyoid depends on the position of the body of the tongue required for each sound.

5. When the pitch is elevated for any purpose, the tip of the thyroid moves definitely upward; when the pitch is lowered, it moves definitely downward. The higher the pitch, the higher the thyroid; the lower the pitch, the lower the thyroid. This is exactly the reverse of the teaching of the textbooks on laryngology, as well as of that of von Meyer and Howard. It is probable that the thyroid moves not only upward but also slightly forward for elevation of the pitch, and not only downward but also slightly backward when the pitch is lowered. Von Meyer,[4] to be sure, observed that with the elevation of the pitch the larynx moved upward, but he maintained that the stretching of the vocal bands resulted from the downward tilting of the thyroid on the cricoid, even though the larynx as a whole was elevated. The falsity of this theory is definitely shown by palpation of the tip of the thyroid. One observes not only the constant elevation of the tip of the thyroid cartilage as the pitch is raised, but also the closer approach of the thyroid to the hyoid bone as the pitch becomes high.

6. The action of the vocal cords in producing the whispered voice is shown by observation of the cords themselves; not only is the glottis usually open much wider than for the loud voice, but also, and of more significance, the cords are not definitely tense, as they are for the production of the loud voice. Palpation of the thyroid cartilage during the production of the whispered voice indicates complete action of the extrinsic musculature, much the same in principle as for the loud voice. But the intensity of muscular action, as well as the range of movement of the thyroid cartilage, is decidedly less than for the loud voice. The thyroid cartilage places itself definitely higher than for the normal loud voice, and in speech moves through a much smaller distance downward. One gains the impression that the movements of both the extrinsic and the intrinsic muscles are practically all present, as for the loud voice, but that they are less exact in action, less intense and slightly modified in their cooperative activities as compared to their action for the normal loud voice. When a speaker definitely attempts to lower the pitch of the whispered voice, the movement of the thyroid is downward and to the

full distance, apparently the same as for the loud voice; but the effect in actually lowering the pitch of the whispered sound is less in degree and not so definite as that resulting from an equivalent movement for altering the pitch of the loud voice. Accordingly the pitch of the whispered voice is high as compared with that of the loud voice, and is not produced with the same definite modulations of pitch; therefore it tends to be more monotonous. The whispered voice apparently is produced through cerebral excitation of the entire intrinsic and extrinsic system of muscles, as is also the loud voice, but with a markedly less degree of intensity. Moreover, it is produced with such an alteration in the manner of excitation as to the extrinsic muscles that the thyroid cartilage is habitually relatively elevated, as compared with the loud voice. Whether the cerebral excitation of the laryngeal musculature for production of the whispered voice differs from that for the loud voice, not merely in degree but also in kind, is open to question.

## SUMMARY AND CONCLUSIONS

1. The larynx, hyoid bone, lower jaw, tongue, soft palate and pharynx, together with their combined intrinsic and extrinsic laryngeal musculature, constitute one united system of organs and muscles for all functions that involve the larynx. Their functions are primarily those of animal life; secondarily, in man, they are employed also as organs of speech. The intrinsic and extrinsic musculature can act, whether for animal functions or for speech, only as one united muscular system. No other psychoneurologic means of action is provided.

2. The peripheral physiology of speech is immediately based on the corresponding basal physiology of the animal functions of the same organs. That the psychology of the peripheral function of speech is based largely on that of certain corresponding animal functions of these organs is probably also true.

3. The extrinsic musculature is attached to the larynx almost exclusively by way of the thyroid cartilage, and thus may apply its laryngeal influence directly to the vocal cords. Through cooperation of the thyroarytenoid muscles, it may presumably alter the details of vocal cord approximation.

4. Studies of laryngeal function, apart from observation within the larynx itself, have been carried out on a wrong principle. Attempts to understand the action of so complex and cooperative a musculature by first studying the anatomy and then speculating as to how the muscles probably act, lead to inadequacy of result, as well as to error. It is possible to know the actual performance of such a musculature only by observation of what it actually accomplishes.

5. The present study of the extrinsic musculature in actual action, by palpation of the upper anterior tip of the thyroid cartilage and adjacent structures, including the trachea, has yielded important physiologic information, as to both normal and abnormal speech.

6. One important error in physiologic observation, that regarding the manner in which the vocal cords are stretched for purposes of elevating the pitch of the voice, has pervaded the textbooks of laryngology for at least seventy-five years. Actual observation of the action of the thyroid cartilage by palpation shows clearly and definitely that elevation of the vocal pitch is produced, not by tilting the thyroid cartilage downward as has been supposed, but by tilting it upward. This is an act of the extrinsic musculature.

7. By similar observation of the actual action of the extrinsic muscles, the whispered voice is found to be produced by joint action of the entire intrinsic and extrinsic musculature, but with certain important differences from their action in the production of the loud voice. Cerebral excitation for the loud voice, as compared with that for the whispered voice, may possibly differ, not merely in degree but also in kind.

8. The interrelation between the movements of the organs of the mouth that determine the elemental sound of speech and the approximation of the vocal cords for the production of voice are so immediately related as to constitute one complex physiologic act.

9. The natural pitch of each elemental English sound is dependent chiefly on the effect of the articulative placement of the body of the tongue on the position of the hyoid bone, and secondarily, on the consequent position of the thyroid cartilage with reference to the cricoid.

104 South Michigan Boulevard.

# SIMULTANEOUS OCCURRENCE OF MULTIPLE LESIONS IN THE ESOPHAGUS

## REPORT OF THREE CASES

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Although diseases of the esophagus are common, the simultaneous occurrence of two or more lesions in the organ is rare. In a number of cases it has been noted that scar tissue in cicatricial stricture of the esophagus has undergone malignant degeneration.[1] It has also been noted in cases of cardiospasm that there may be associated a pulsion-traction type of diverticulum of the middle portion of the tube.[2] In examination of the esophagus, the possibility of two or more independent lesions existing at the same time should always be borne in mind. The necessity for such care is illustrated by the following cases:

CASE 1.—A man, aged 63, was examined at the Mayo Clinic, May 22, 1924. Ten years previously he had begun to regurgitate food during the night, and had noticed a gurgling sound when he swallowed. Eighteen months previous to examination, the symptoms had become more marked, the patient had a sense of obstruction to food in the upper part of the esophagus, and he regurgitated food ingested at the beginning of the meal. He had lost sleep because of the nocturnal regurgitation of food and mucus, and had lost 70 pounds (31.8 Kg.) in weight.

Roentgen-ray examination revealed a pharyngo-esophageal diverticulum (fig. 1.) Sounds were passed into the stomach without difficulty, guided by a silk thread which had been swallowed. The passage of the sounds was associated with slight bleeding, which rarely occurs with uncomplicated diverticulum. On examination, a firm, bleeding, granular mass was found in the diverticulum; it extended to the posterior margin of the esophageal opening. Tissue removed for microscopic examination proved to be from a squamous cell epithelioma, grade 3 (fig. 2). An attempt was made to remove the tumor along with the diverticulum, but it was too extensive for resection. Radium treatments proved ineffectual, and the patient died the following September.

CASE 2.—A man, aged 76, was examined on April 30, 1925. Five years previously he had begun to notice difficulty in swallowing solid food. He was unable to locate the point of obstruction, but after each meal a part of the food was regurgitated. Dysphagia gradually progressed with a loss of 30 pounds (13.6 Kg.) in weight.

Roentgenograms showed a pharyngo-esophageal diverticulum and a large circumscribed tumor in the mediastinum on the right side (fig. 3). The patient

1. Vinson, P. P.: Cicatricial (Benign) Stricture of the Esophagus: Tabulated Report of One Hundred Eighty-Six Cases, Ann. Otol. Rhin. & Laryn. **36**:40, 1927.

2. Vinson, P. P.: Cardiospasm Associated with Esophageal Diverticula, New York M. J. **117**:540, 1923.

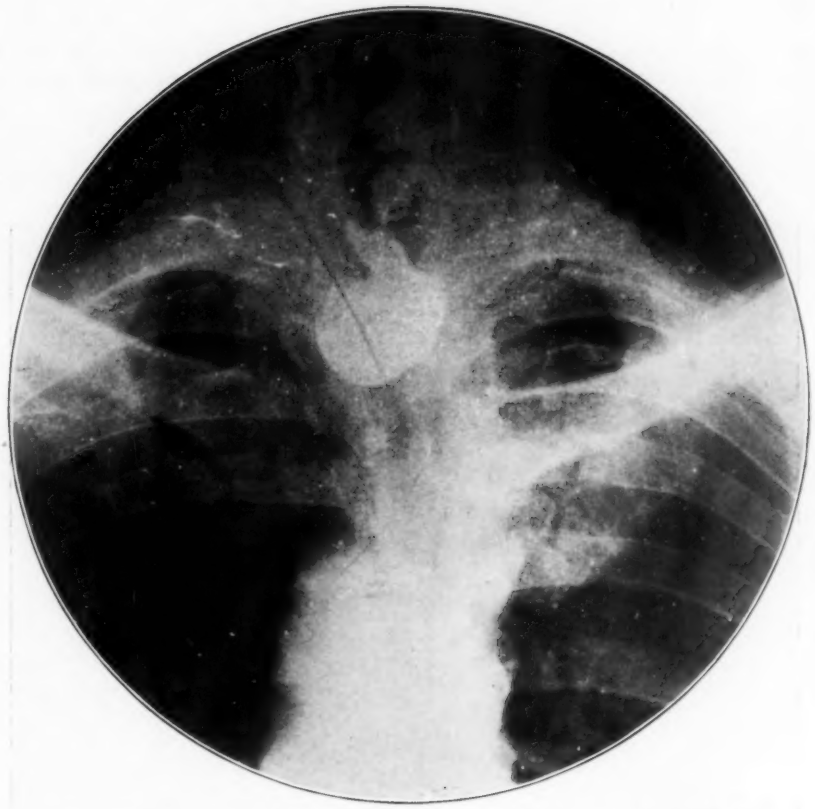

Fig. 1.—Pharyngo-esophageal diverticulum complicated by epithelioma.

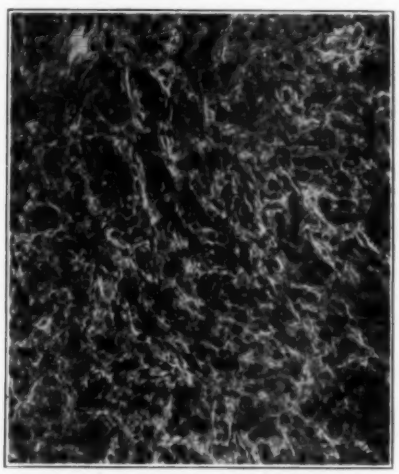

Fig. 2.—Tissue removed from the lesion in the diverticulum, showing squamous cell epithelioma; × 120.

was unable to swallow a thread; the degree of dysphagia was much more marked than is usual for this type of lesion. It was believed that malignant degeneration had occurred in the diverticulum and that the mediastinal tumor was metastatic. On esophagoscopic examination, the diverticulum did not show evidence of malignant change, but in the median esophageal region there was a firm growth covered with necrotic tissue. A specimen removed for microscopic

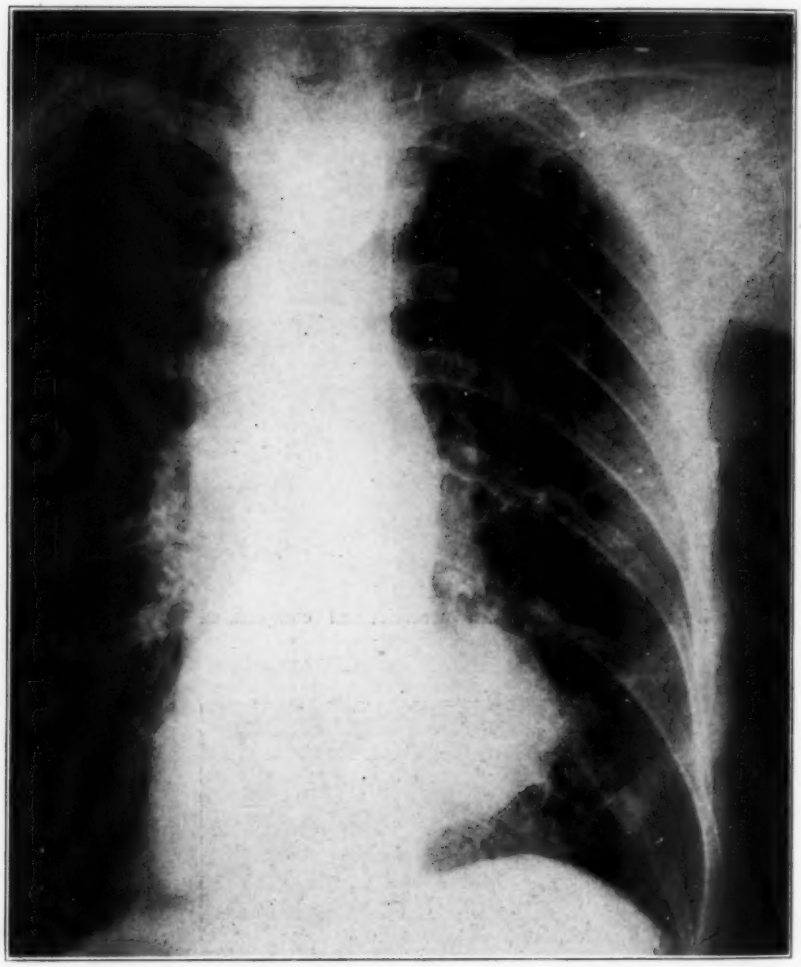

Fig. 3.—Pharyngo-esophageal diverticulum and tumor in the lower part of the mediastinum on the right side.

examination was reported to be inflammatory by the pathologist; grossly, it appeared malignant. The patient's condition gradually became worse, and he died at his home about a year later. A postmortem examination was not made.

Case 3.—A man, aged 69, presented himself for examination on Sept. 28, 1926. Nine months previously he had begun to notice an obstruction to the passage of solid food in the lower part of the esophagus. Dysphagia had progressed

gradually, until he was unable to take anything but fluids at the time of examination. He had lost from 15 to 20 pounds (from 6.8 to 9 Kg.) in weight.

Roentgenograms revealed carcinoma of the upper part of the esophagus with marked obstruction (fig. 4). The stricture was dilated to 45 French with complete relief from dysphagia. After a time, respiratory infection and a cough developed, and the possibility of an esophagotracheal fistula was considered. A

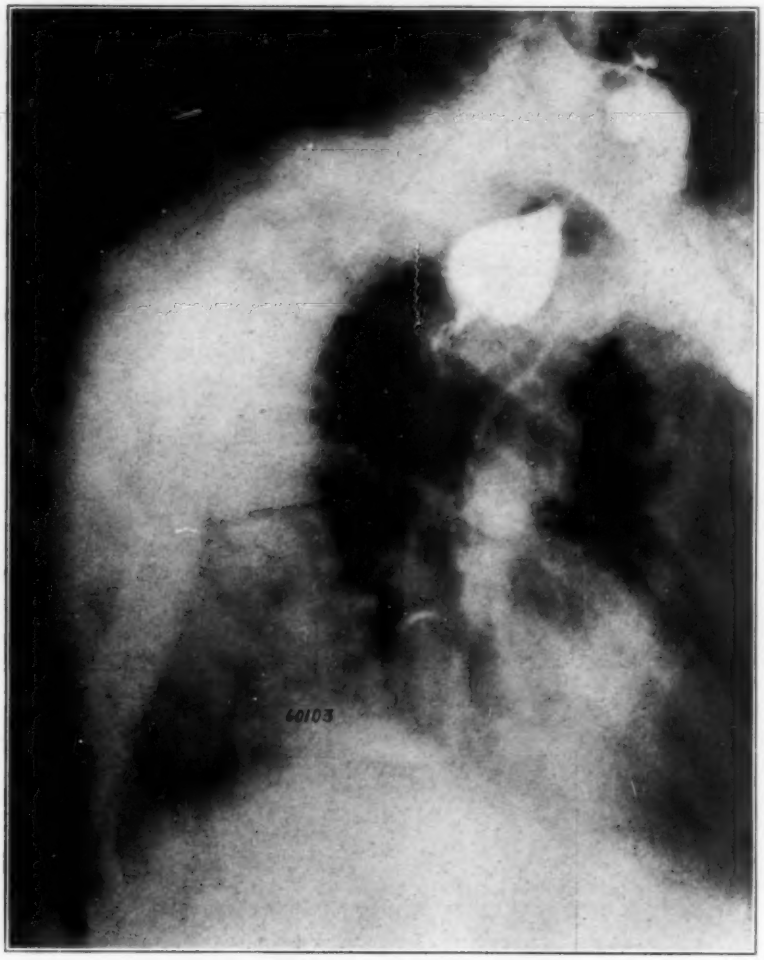


Fig. 4.—Carcinoma of the upper part of the esophagus.

second roentgenogram of the esophagus was made and this time the barium passed beyond the stricture in sufficient quantity to reveal a diverticulum of the esophagus, just above the cardia (fig. 5). The second lesion was apparently not a factor in the dysphagia. Tissue from the upper esophageal lesion revealed squamous cell epithelioma, grade 3 (fig. 6). Passage of a sound once a month permitted free deglutition, and the patient is still able to carry on his usual activities.

Fig. 5.—Diverticulum of the lower part of the esophagus.

Fig. 6.—Malignant tissue removed from the lesion in the upper part of the esophagus; × 120.

# DISTINGUISHING BETWEEN TACTILE SENSE AND AUDITION IN THE DEAF CHILD*

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PHILADELPHIA

When a deaf child is examined it is always uncertain whether the vibration of the testing instrument is heard or felt. This uncertainty exists even when the examiner has taken the utmost pains to make the child understand that the report of hearing alone is desired. As these children usually are not advanced in receiving and understanding communication, the idea that the examiner wishes to convey is often uncertain in the child's mind.

The method recommended at present is one of mimicry. The child stands in front of the examiner, and sees him strike a fork and hold it to his ear; he sees him incline the head as if listening; he sees him look off into space and nod the head affirmatively. The fork is struck again, and is put to the child's ear (the fork being held vertically, with the flat side of the tine toward the meatus). The response may be prompt and certain or slow and doubtful; the nod of the head may mean nothing but mimicry or merely the reporting of tactile sense. The child will nod in any way suggested to him.

In order to distinguish whether the child hears or whether he is reporting the feeling of the fork's vibration,[1] the following method is suggested:

First: It is necessary to use a large fork, no matter what pitch is being tested, in order to reach the remnant of hearing which most deaf children have. Only a large fork will give sufficient loudness or intensity; yet it is the large fork which gives the greatest tactile impulse.

Second: Strike the heaviest blow possible with the fork. The rubber heel on the shoe is convenient for this purpose; a thick rubber block may be used instead. Time the duration of the tactile sense by your own sensation. The fork is held vertically, with the flat side of one tine against the external auditory meatus. This position gives the greatest auditory and tactile stimulus. Take a number of readings, for the blow will vary, and, consequently, the time will vary. Average the results so as to get a "mean tactile impression-time."

The deaf child should receive this tactile impression as long as the normal child does.

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* National Survey of the Deaf Child, instituted by the National Research Council, of which Dr. Charles W. Richardson is chairman.

1. It is not possible to discriminate between tactile and auditory impressions received from the audiometer, when at full strength. When the 3A audiometer is used, tactile interference appears at a setting of 85 to 90 per cent loss in hearing. When the receiver is in contact with the auricle, the vibration is felt at even weaker intensities.

If the examiner is sure that the child is reporting with positiveness, after the "mean tactile impression-time" has passed, it can be surmised that the child is reporting hearing.

Third: If the child fails to respond, or if he gives a negative response during the "mean tactile impression-time," he may be reporting either tactile or auditory impressions.

Determine the child's reporting time by a number of trials. With a fair idea of what this is, continue the testing with the fork, but rotate it on its long axis

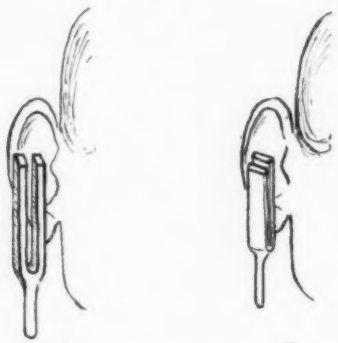


Fig. 1.—*A* represents the first position of the fork for testing, with the flat side of the tine against the external auditory meatus; *B* shows the second position, in which the flat side of the tine presents its vibrations to the pinna.

Fig. 2.—Graphic representation of the interference of sound waves coming from the tines of a fork (looking down on top of the tines).

in front of the meatus. In the second position, the flat side of the tine is presenting its vibrations to the pinna, which is receiving tactile impressions as long as the normal "mean tactile impression-time." Coming from the edge of the tine are audible vibrations of less intensity than those from the flat of the tine. The reason for the weaker tone from the edge of the fork is the interference of the waves from the flat wide side with those from the flat narrow side. If the child is reporting audition, the reporting time should be shortened.

# EPHEDRINE AND COCAINE SYNERGY*

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It is a well known fact that the action of cocaine and epinephrine on the blood pressure is synergistic. It has been shown that this synergy between cocaine and epinephrine includes toxicity. Moderate amounts of epinephrine markedly increase the poisonous effects of cocaine.[1]

Chen and Schmidt[2] showed that ephedrine possesses most of the properties of epinephrine, in that it stimulates the sympathetic nervous system. They showed that the action is chiefly peripheral, but that with large doses it extends to central stimulation. The drug differs from epinephrine in that it maintains an increased blood pressure for a longer time.

Chen and Schmidt[3] proved that ephedrine stimulates the stellate ganglion.

Chen and Meek[4] demonstrated synergistic action between ephedrine and epinephrine, as far as the action on the blood pressure is concerned.

If ephedrine produces changes identical with those produced by epinephrine, its action on the blood pressure and toxicity is synergistic with cocaine. I have been unable to find that any work has been done on this point.

## EXPERIMENTAL WORK

Dogs were used to make studies of the blood pressure. The animals were anesthetized by giving intraperitoneally 1 cc. of a 25 per cent solution of chloretone in olive oil per kilogram of body weight.

The drugs were injected into the femoral vein and pumped in with a Woodyatt pump at the rate of about 2 cc. a minute until the respiration stopped.

Blood pressure was recorded on a kymograph drum from a manometer connected with the carotid artery.

The strength of the cocaine solution was 0.5 per cent, which was found most suitable in previous work.

The first group of dogs was given cocaine alone to determine the minimal lethal dose for the conditions and the changes in the blood pressure. The results are given in tables 1 and 2. Table 1 gives the original data, and table 2 includes the calculated conclusions.

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* From the Departments of Otolaryngology and Pharmacology, Northwestern University Medical School.

1. Ross, E. L.: J. Lab. & Clin. Med. **8**:656, 1923.

2. Chen, K. K., and Schmidt, C. F.: The Action and Clinical Use of Ephedrine, J. A. M. A. **87**:836 (Sept. 11) 1926.

3. Chen, K. K., and Schmidt, C. F.: J. Pharmacol. & Exper. Therap. **24**:339, 1924.

4. Chen, K. K., and Meek, W. J.: J. Pharmacol. & Exper. Therap. **28**:59, 1926.

The second group of animals was given 0.1 per cent solution of ephedrine chloride for a period of about ten minutes. An interval of from thirteen to seventeen minutes was allowed to pass before the injection of 0.5 per cent cocaine hydrochloride and 0.1 per cent ephedrine hydrochloride was begun. The observations on changes in the blood pressure are given in tables 3 and 4.

The third group of dogs was given cocaine hydrochloride (0.5 per cent) and ephedrine (0.1 per cent) until dead. The results are recorded in tables 5 and 6.

TABLE 1.—*Administration of Fatal Doses of Cocaine*

| Dog | Weight, Kg. | Quantity injected, Cc. | Duration, Minutes | Blood Pressure | |
|---|---|---|---|---|---|
| | | | | Initial | Maximum |
| 1 | 5.75 | 26.0 | 14 | 90 | 111 |
| 2 | 3.90 | 9.0 | 4 | 92 | 124 |
| 3 | 10.00 | 29.0 | 15 | 66 | 66 |
| 4 | 6.70 | 21.5 | 11 | 114 | 132 |
| 5 | 7.00 | 17.0 | 7.5 | 82 | 90 |

TABLE 2.—*Administration of Fatal Dose of Cocaine*

| Dog | Minimal Lethal Dose of Cocaine, Gm. per Kg. of Body Weight | Blood Pressure Increase |
|---|---|---|
| 1 | 0.0226 | 21 |
| 2 | 0.0115 | 32 |
| 3 | 0.0145 | 0 |
| 4 | 0.0160 | 18 |
| 5 | 0.0121 | 8 |
| Average | 0.0153 | 14 |

TABLE 3.—*Administration of Cocaine and Ephedrine After Ephedrine*

| Weight of Dog, Kg. | Injection Interval, Minutes | Blood Pressure | | | |
|---|---|---|---|---|---|
| | | Ephedrine | | Cocaine and Ephedrine | |
| | | Initial | Maximum | Initial | Maximum |
| 3.7 | 13 | 94 | 135 | 124 | 132 |
| 8.5 | 13 | 96 | 141 | 102 | 102 |
| 7.0 | 17 | 140 | 194 | 114 | 132 |

TABLE 4.—*Administration of Cocaine and Ephedrine After Ephedrine*

| Dog | Rise in Blood Pressure from Ephedrine | Rise in Blood Pressure from Ephedrine and Cocaine |
|---|---|---|
| 1 | 41 | 8 |
| 2 | 45 | 0 |
| 3 | 54 | 18 |
| Average | 47 | 9 |

A final group of animals was given intraperitoneal injections of cocaine and ephedrine of varying strengths. No anesthesia was used. Cats were considered more suitable for this part of the work. The summary of the results is given in table 7.

## COMMENT

Observations were made on the first group of dogs to determine the minimal lethal dose of cocaine absorbed at the rate of about 0.01 Gm. a minute for dogs anesthetized with chloretone. At the same time, the

changes in the blood pressures were recorded. In tables 1 and 2 it is observed that the individual variation is considerable. The average minimal lethal dose of cocaine hydrochloride was 0.0153 Gm. per kilogram of body weight. The average rise in the blood pressure was 14 mm. of mercury.

TABLE 5.—*Administration of Fatal Dose of Cocaine and Ephedrine*

| Dog | Weight, Kg. | Quantity Injected, Cc. | Duration, Minutes | Blood Pressure | |
|---|---|---|---|---|---|
| | | | | Initial | Maximum |
| 1 | 5.75 | 37.5 | 18.2 | 99 | 132 |
| 2 | 8.00 | 38.0 | 19.0 | 66 | 87 |
| 3 | 9.00 | 26.0 | 12.0 | 96 | 104 |
| 4 | 3.25 | 23.0 | .... | 126 | 150 |
| 5 | 6.50 | 22.0 | 10.0 | 114 | 138 |
| 6* | 6.33 | 39.0 | .... | 120 | 132 |

* Dog 6 was given 0.06 per cent ephedrine with cocaine.

TABLE 6.—*Administration of Lethal Dose of Cocaine and Ephedrine*

| Dog | Minimal Lethal Dose of Cocaine, Gm. per Kg. of Body Weight | Blood Pressure Increase |
|---|---|---|
| 1 | 0.0326 | 33 |
| 2 | 0.0240 | 21 |
| 3 | 0.0144 | 8 |
| 4 | 0.0353 | 24 |
| 5 | 0.0170 | 24 |
| 6* | 0.0308 | 12 |
| Average | 0.0257 | 20 |

* Dog 6 was given 0.06 per cent ephedrine.

TABLE 7.—*Intraperitoneal Cocaine and Ephedrine Injections in Cats*

| No. | Drugs | | Spasticity | Convulsions | Death |
|---|---|---|---|---|---|
| | Cocaine, per Cent | Ephedrine, per Cent | | | |
| 1 | 5 | 2 | After 32 minutes | After 2 hours | 2 hours, 20 minutes |
| 2 | 5 | 2 | After 20 minutes | After 25 minutes | 1 hour, 30 minutes |
| 3 | 4.5 | 2 | After 3 hours | No | No |
| 4 | 4.5 | 2 | No | No | No |
| 5 | 3.5 | 3 | After 2½ hours | No | No |
| 6 | 3.5 | 2 | After 15 minutes | After 20 minutes | 10 to 24 hours |
| 7 | 3 | 3 | After 30 minutes | After 3 hours | No |
| 8 | 3 only | .. | After 30 minutes | After 35 minutes | No |
| 9 | 3 only | .. | After 20 minutes | After 25 minutes | No |
| 10 | 3 only | .. | After 2¼ hours | After 3 hours | No |
| 11 | 3.5 only | .. | After 15 minutes | After 20 minutes | 1 hour, 25 minutes |
| 12 | 3.5 only | .. | After 10 minutes | After 17 minutes | 1 hour, 5 minutes |

The second group of dogs was used to determine the average rise in the blood pressure produced by a medium dose of ephedrine and by the same dose of ephedrine used with cocaine. Tables 3 and 4 give the results obtained on three dogs. The average rise in the blood pressure produced by ephedrine alone was 47 mm.; that due to ephedrine and cocaine was 9 mm. of mercury.

If ephedrine is synergistic with cocaine in raising the blood pressure, the increase due to ephedrine and cocaine should be greater than the sum of the individual rises due to the two drugs. The rise due to cocaine was 14 mm., and that due to ephedrine was 47 mm. The rise due to the two drugs acting together was not over 61 mm., but only 9 mm. of mercury. The same measurement of the combined action of ephedrine and cocaine was made in the third group of dogs. Table 6 shows that the average rise for the group was 20 mm. of mercury, which also is not even equal to the sum of the individual actions of the drugs. Therefore, it must be concluded that there was no synergy between ephedrine and cocaine in the experiments.

The minimal lethal dose of cocaine when accompanied by ephedrine, determined in tables 5 and 6, averages 0.0257 Gm. of cocaine hydrochloride. The minimal lethal dose of cocaine alone was only 0.0153 Gm. This difference means a decrease of 40 per cent in the minimal lethal dose of cocaine. It is clear that for dogs anesthetized with chloretone, cocaine was much less toxic when used with ephedrine than when used alone.

Table 7 indicates that 1 cc. of a 5 per cent solution of cocaine hydrochloride per kilogram of body weight was uniformly fatal to cats not anesthetized when they were treated with ephedrine . When ephedrine was used with cocaine, the 4.5 per cent and the 3.5 per cent solutions were fatal in only one case, in which death occurred some time between ten and twenty-four hours after the drug was given. This fatal case was not one of acute poisoning. The cats given 3 per cent cocaine alone had convulsions promptly, but did not die; those given 3.5 per cent cocaine only, developed convulsions within a few minutes and died within two hours. These results indicate clearly that the ephedrine increased the toxic concentration from 3.5 per cent to fully 4.5 per cent solution; this difference amounts to a decrease of over 22 per cent. Clearly, the toxic dose of cocaine is increased by the use of ephedrine in cats that have not been anesthetized.

## SUMMARY AND CONCLUSIONS

Cocaine was slowly introduced into the circulation of dogs; the minimal lethal dose was established, and the rise in blood pressure determined. Under the same conditions, cocaine and ephedrine were injected and the same factors measured. Still another group of animals was given ephedrine, and after the action had subsided, cocaine and

ephedrine were injected as in the second series of tests. The minimal lethal dose was determined for cocaine and for cocaine and ephedrine injected intraperitoneally into cats that had not been anesthetized. The conclusions are as follows:

1. Ephedrine and cocaine do not act synergistically on the blood pressure like epinephrine and cocaine.

2. Ephedrine does not increase, but decreases the toxicity of cocaine.

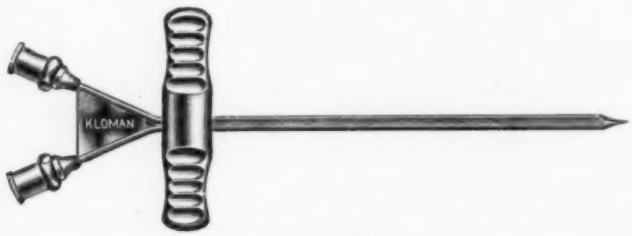
# Clinical Note

## A NEW ANTRUM NEEDLE

L. E. Daugherty, M.D., Cumberland, Md.

So much has been said of the danger from blowing air into the antrum after puncture, especially if any force is required and because one finds the natural ostium closed by swelling or polypoid tissue in so many cases, that I have devised an instrument for such use. The instrument is shown in the accompanying illustration.

As I was satisfied with a needle the size and shape of the Lichwitz needle and as I so often failed to get air in or out and yet was positive it was in the antrum, its presence often being confirmed by the roentgen ray, I conceived the idea that a double channel within the needle would allow the return of air or fluid in almost any case. It would almost eliminate any possibility of causing emphysema or of blowing pus into overlying soft tissues in case the needle was not in the antrum.




Antrum Needle

Openings with attachments similar to the usual Lichwitz needle have been provided, and the shape and ease of grasping the needle allows greater freedom in making punctures. The technic is the same as with the Lichwitz needle. No more force is required, and there is absolute assurance that this means of diagnosis and treatment is totally without danger in the hands of any otolaryngologist.

Instead of being round, the needle is slightly flattened, which gives it more security when it is once in place.

### SUMMARY

The points of advantage are:

1. Ease of manipulation.
2. Increased stability when once placed.
3. The return of the fluid through the natural ostium, when it is patent: the return of the fluid through the needle when the natural ostium is closed.
4. The ease with which the needle is inserted beneath the turbinate because of its flatness.
5. Absolute assurance of washing the antrum without further trauma, even though the natural ostium is closed.

# Progress in Otolaryngology

## A Summary of the Bibliographic Material Available in the Field of Otolaryngology

## CHRONIC PROGRESSIVE DEAFNESS

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OTTAWA, CANADA

### OTOSCLEROSIS

For some time it has been realized that microscopic study of the temporal bones was not likely to lead any further in the understanding of the more important forms of deafness such as otosclerosis and nerve deafness. No new facts have been discovered in histology, and there is still considerable difference of opinion as to the interpretation of the appearances seen. Of late years some of these problems have been attacked from a new angle, notably that of biochemistry, and data have been obtained that begin to throw new light on the etiology of otosclerosis and nerve deafness. There is now at last a prospect, however faint, that the principles of a rational and effective treatment for otosclerosis may in a few years be worked out.

Many authorities have believed for some time that otosclerosis was connected in some way with a constitutional disorder brought about by malfunction of the ductless glands. Frey [1] supports this view, and the reasons for so doing are: 1. It has a marked hereditary tendency. 2. It shows a preponderance in the female, with a tendency to become worse at puberty, in pregancy, and at the climacteric. 3. Psychic disturbances influence it adversely. 4. The vasomotor system is affected, and this in its turn is related to the ductless glands. 5. It is occasionally found with other abnormalities, such as fragility of the bones and blue sclerotics. 6. Patients with otosclerosis have diminished blood calcium, and on this account Frey believes that the parathyroid glands are probably at fault.

During the war, Frey examined a number of otosclerotic patients in collaboration with a neurologist. They found that none of them were quite normal. Most of them showed symptoms resembling those of chronic tetany. Patients with chronic tetany show electrical hyperirritability and fibrillary tremor, together with Trousseau's and Chvostek's signs. Not all otosclerotic persons, however, show all these symptoms. Frey recommends roentgen-ray irradiation of the ears and

1. Frey: J. Laryng. & Otol. **41**:698 (Oct.) 1926.

the hypophysis as well as of the thyroid and parathyroids. He also gives potassium iodide and a staphylococcic vaccine. He does not claim to have effected cures, but thinks that some improvement has been obtained.

Eckert-Moebius [2] recalls his earlier work on the vascularization of the petrous bone and distinguishes two groups of vessels, viz., a group growing into the primitive cartilage supplying the cartilage-forming centers, and a second set which grows in when ossification takes place. He names certain areas in which the cartilage canal systems occur: (1) in front of the oval window; (2) in the corner between the internal meatus and the base of the cochlea; (3) in front of the round window and streaming into the niche from the floor of the middle ear. These correspond with the commonest sites of otosclerotic changes.

He states further that there are three factors that are associated in the occurrence of otosclerosis: first, a general constitutional component, a disturbance in the mesenchyme brought about by an hereditary abnormality in the ductless glands; second, a local component, viz., areas of badly vascularized, biologically poor tissue in the boundary zones between the terminals of the cartilage vessels and the secondary bone vessels; third, an exciting component, such as general and perhaps also local metabolic changes, which explain the incidence in females and in the years of adolescence, as well as the influence of gravidity, etc.

Brunner,[3] describing the microscopic changes in three cases of otosclerosis, gives a resumé of the current theories of its etiology. Manasse thinks the primary change is a formation of new bone around the vessels. Siebenmann holds that the primary change is absorption of the old bone by osteoclasts. Wittmaack holds that the changes are due to venous engorgement, etc. Brunner believes that the condition is due to metabolic changes caused by the endocrine glands. The reason, he states, that these changes do not occur in other bones is that in the petrous bone an infantile type of chondroid bone persists through life.

Drury,[4] in an interesting study of otosclerosis, strongly supports the hypothesis that it is closely associated with metabolic disturbances brought about in many instances by the ductless glands. He states:

> I offer as a suggestive etiologic factor in otosclerosis the assumption that it (otosclerosis) begins about the time of puberty. We know that youth is the plastic age. During this period the cells that are on their way toward specialization may, if conditions become altered, especially in a predisposed person, dedifferentiate, becoming thereby embryonal again; and then they start off on a new line of differentiation. For example, an individual with the correct determinants, through a chemical change in the body, possibly controlled in activity by the

2. Eckert-Moebius: Verhandl. Gesellsch. deutsch. Hals-Nasen-u. Ohrenaerzte, München. Ztschr. f. Hals-, Nasen-u. Ohrenh. **12**, 1925.

3. Brunner, H.: Festschrift f. Alexander, Zentralbl-. f. Ohrenh. **27**:45, 1926.

4. Drury, D. W.: Rhin. & Laryng. **35**:651 (Sept.) 1926.

endocrine glands, passes toward puberty, then the embryonic cells again appear, influenced possibly by the persisting embryonic cells remaining in the cartilage, differentiates into a new bone formation in the labyrinthine capsule.

He also states:

In a study of the connection of otosclerosis with disturbed function of the endocrine system covering a period of two years and involving careful observation and study of a series of over a hundred cases, the writer has found that fully one third of all of the series gives neither subjective nor objective evidence of any endocrine disturbance. Of the residual two-thirds of the cases cited, endocrine foci have been more or less definitely incriminated and severally include the thyroid, the pituitary and the gonads. The absence of adrenal cases from the group may as well be ascribed to the paucity of cases presenting disease of these organs as to a failure of the influence analogous to that established for the other ductless glands. The conclusions drawn from these studies and from other series of observations by the writer connected with investigations of the entire topic would be that the endocrine influence is an indirect and nonspecific one.

In his summary he says:

It would seem to be established that many and widely divergent factors can excite the appearance of otosclerosis in a predisposed person.

The essential factor underlying the morbid change is possibly a chemical one affecting the nutritive stability of developing and fully developed bone and cartilage.

In a dominant percentage of cases the several endocrine glands are direct etiologic factors through their influence on normal metabolism.

In cases of otosclerosis without firm ankylosis of the footplate of the stapes or other irreversible organic changes, a response to the proper glandular treatment may be expected with reasonable confidence.

The constitutional tendency or hereditary influence would seem to be a dominant factor in determining the condition of otosclerosis where an endocrine or nonendocrine pathology produces disturbances of metabolism.

### ENDOCRINE STUDIES IN OTOSCLEROSIS

Lawrence [5] contributes a paper on the study of thirty-one cases of progressive noninfectious deafness, in which the patients had been under treatment for from six to eighteen months. They had all been referred by otologists, with the diagnosis of otosclerosis. The study of these cases included a careful history and physical examination, with a Wassermann reaction in every case, and such special examinations by ophthalmologists, roentgenologists or other consultants as were indicated.

One of the interesting points brought out in this paper is that in normal people the hearing acuity is influenced less by training or vocation than by the nutritional level of the individual.

In six of the thirty-one cases focal infection was present to a degree sufficient to account for the malnutrition. Twenty-two patients showed definite evidence of deranged metabolism, the type of derangement indicating endocrine malfunction. Thyroid failure was discovered in eight cases, pituitary disorder in seven cases, and gonad failure in seven cases, the last mentioned patients all being females. Eighty-two per cent of these patients complained of being easily fatigued. Forty-one per

5. Lawrence, C. H.: Laryngoscope **36**:779 (Nov.) 1926.

cent of the patients having endocrine disturbances complained of tinnitus and 9 per cent of vertigo. Twenty-one of the twenty-two patients having endocrine disturbances were women, and sixteen of these showed some abnormality in menstruation. On physical examination in the nonendocrine group, chronic infection of the accessory nasal sinuses was the previously undiagnosed condition most commonly encountered. The majority of the cases showed definite evidence of malnutrition. Thus, nine patients were more than 10 per cent underweight, and four were more than 10 per cent overweight, giving 59 per cent whose weight was distinctly abnormal. Ninety per cent of the patients having endocrine disturbances had lowered blood pressure; 63 showed basal metabolic rates below normal; 77 per cent showed subnormal alveolar carbon dioxide tension. Fifty-four per cent showed an abnormally high amount of undetermined nitrogen in the urine, and 22 per cent showed an increase in one or another of the blood nitrogen constituents. The Wassermann reaction was negative in every case.

From the fact that the cases showing thyroid, pituitary, and gonad disturbances occurred in practically equal numbers, it is evident that there is no specific action on the hearing but rather on the nutritional level of the body as a whole, with its resulting effect on the ears. Nineteen of the patients were tested with endocrine extracts, and were under treatment at least six months. Seventy-three per cent of those treated showed some improvement, and 27 per cent have shown none. The improvement was marked in four patients. These became free from tinnitus and remained so for six months or more, and the hearing also improved. In the nonendocrine group, two patients in whom the deafness was associated with anemia have shown definite improvement in hearing as the blood picture has approached normal. Most of the cases in which improvement did not occur were of long duration, averaging 9.8 years.

The patients who showed the most improvement were those who had thyroid or pituitary disturbances. The ovarian disorders were much more unsatisfactory under treatment, only one of the nine cases showing definite improvement. This is probably due to the absence of a satisfactory ovarian extract. The thyroid disorders responded rapidly. The cases of pituitary disturbance were slower and required generous amounts of extract. All medication was by mouth.

Lawrence's conclusions were as follows:

1. Thirty-one cases of progressive noninfectious deafness (otosclerosis) in which the metabolism studies were made are reported. Of these, twenty-two, or 70.9 per cent, showed definite evidence of metabolic disturbances.

2. The nature of these disturbances indicates that their origin lies in endocrine malfunctions.

3. The unfavorable effect of pregnancy upon deafness of this type may be explained upon the basis of its influence on the metabolism via the endocrine apparatus.

4. The auditory apparatus is peculiarly sensitive to systemic conditions, either because of its developmental characteristics, or in certain individuals of an inherited lowered resistance.

5. Treatment of the metabolic derangement associated with the deafness by administration of an extract of the endocrine gland at fault resulted in improvement in hearing in fourteen out of nineteen cases—73.6 per cent.

Rowe [6] points out the general principles and difficulties attendant on the estimation of endocrine function in relation to otosclerosis. He states that two out of three otosclerotic patients exhibit signs of endocrine malfunction. The third is rigorously nonendocrine. In this connection, only a small percentage of cases showing endocrine aberration exhibit otosclerosis as a concomitant or resultant defect.

Discussing metabolism tests, Rowe points out that most of them are based on the assumption that a single definite function of the human body finds its genesis and regulation in a single group of cells. This is basically incorrect, as it has been demonstrated that the vital function tests are not specific. No one test alone is adequate to establish a diagnosis. "The practice, for example, of returning a diagnosis of hypothyroidsim on the single observation of a basal rate measurement some 20 per cent below the calculated normal is wholly misleading. True, a moderate thyroid failure will produce a drop in the basal rate of this magnitude, but equally a functional failure of the ovary, of the anterior lobe of the pituitary, and among nonendocrine entities a partial inanition will produce an equivalent level."

In arriving at conclusions, tests widely varying in type were tried on large numbers of so-called normal individuals to obtain some criteria of normalcy. Other cases showing concrete and demonstrable pathologic conditions produced by surgical intervention were then studied, but here a possible fallacy arises in that there is apparently more than one separate function in several of the glands in question.

The thyroid gland exercises the most influence on the basal rate. The pituitary gland runs in the same direction but to a lesser degree. With regard to sugar tolerance and the galactose test, there is a difference between the male and the female, 30 Gm. being necessary to produce a transitory melituria in the former and 40 in the latter. Oophorectomy or extremely lowered functional activity of the sex glands in the female lowers the threshold tolerance to 20 Gm., the level before puberty. With the male, on the other hand, the testicle does not exercise any influence on the galactose tolerance. This is of great diagnostic import.

In his concluding remarks, Rowe points out that endocrine therapy is specific, and that a case of otosclerosis due to deficiency of the thyroid gland will not be benefited by pituitary medication, and vice versa. Accurate diagnosis is essential before therapy is likely to be of much avail.

6. Rowe: Laryngoscope **33**:551 (Aug.) 1926.

Shambaugh and Holderman [7] contribute a paper on otosclerosis based on the study of 113 patients seen by Shambaugh. In ninety-two of these cases the drumhead was normal. In fifteen, there was a distinct pinkish glow from the promontory. This sign, when present, is regarded as pathognomonic of otosclerosis. In 105 of the cases the functional tests indicated fixation of the stapes. In all, there was at the same time a more or less extensive lowering of the upper tone limit. In eight patients, the functional tests were those of primary nerve deafness. Diagnosis in cases of this type is obviously much more difficult and was made on the period of onset, history of other cases of otosclerosis in the family, and the absence of any other discoverable cause for nerve deafness. Paracusis willisiana was recorded in sixty-four cases. This symptom is rarely found except in cases of otosclerosis with fixation of the stapes on both sides. In most of these cases, ability to hear well over the telephone was present. This is apparently due to increased bone conduction.

### PARACUSIS

With regard to paracusis, Knudsen and Jones [8] have carried out some painstaking work to determine whether or not patients with paracusis actually hear better in a noise, and if so, to what extent. The result of their experiments shows that all persons, whether paracusic or not, hear less well in a noise than in a quiet place. This applies not only to pure tones but also to conversation. Thus, patients with paracusis actually do not hear better when there is noise than when it is quiet, although they often think they do. Paracusis occurs only in patients with a conductive lesion of fairly high degree. In these patients, the lower tones are heard poorly or not at all and, hence, if the noise is mainly of low frequency, it does not disturb a patient with paracusis to the same extent as it disturbs a person with normal hearing or one with nerve deafness. In the presence of a noise of a given intensity, the hearing of a normal person may be reduced perhaps 30 per cent, while at the same time a paracusic person will have his hearing reduced by only 8 or 10 per cent, and hence enjoys a relative advantage, as the hearing of the two tends to become more nearly equal. Paracusic persons generally have fairly good hearing in the middle tone ranges, while tones of low frequency are badly heard. The noise of traffic or the rumble of a railway train are, for the most part, of low frequency and are not heard by paracusic persons. At the same time, a normal person invariably raises his voice in the presence of a noise, and the paracusic person hears it better than if there were no noise and the voice

7. Shambaugh and Holderman: Tr. Am. Otol. Soc. Montreal, June, 1926, p. 468.

8. Knudsen and Jones: Laryngoscope **36**:623 (Sept.) 1926.

were at the ordinary level. Also the paracusic person does not raise his voice in a noise as he is not disturbed by it, and on account of his conductive lesion his voice sounds loud to himself. Hence, a normal person is at a relative disadvantage in comparison with a paracusic person.

Knudsen and Jones summarize their results as follows:

"(1) The results of experiments show that the paracusic does not hear better in the presence of a noise. He hears less well in presence of a slight noise and his hearing is more and more interfered with as the loudness of the noise is increased. The evidence indicates that all individuals hear better in the quiet than in the presence of a noise.

"(2) The paracusic has a relative advantage over the normal, or over the individual with perceptive deafness, in the presence of a noise."

Bunch[9] describes the hearing tests in otosclerosis. The material studied consisted of sixty-three cases of otosclerosis uncomplicated by the presence of other ear conditions. As regards the age of onset, 35 per cent of the patients reported that deafness was noted before the end of the sixteenth year. Eighty-four per cent of the patients were under 40 years of age. The sex ratio was 60 per cent female to 40 per cent male.

The Rinne test was negative in 117 ears and was positive in four. Three tests were doubtful. Twenty-nine ears showed a decrease in bone conduction and were classified as atypical with regard to Bezold's triad. Weber's test gave little help in this condition. Gellés test gave a positive fixation response in eighty-seven ears. It was negative in eight and doubtful in thirty. The lower limit was considerably raised in all. There was marked loss of acuity for the 4,096 double vibration fork in most cases. The upper tone limit was determined by the Struycken monochord for both air conduction and bone conduction, and the upper tone limit by air conduction was uniformly less than normal, while bone conduction was above normal.

Tinnitus was noted as a disturbing factor in 88 per cent of the cases. In this group, tinnitus did not appear to be the first symptom. Paracusis was noted in thirty-one cases and was absent in twenty-three, and in five its presence was doubtful.

The cases are classified into three groups according to their audiometric records, inner ear, middle ear, and combined types. The first group comprised thirty-one ears. It consisted of an island of hearing usually lower than 1,500 double vibrations with the upper tones absent. The middle ear type comprised fifty-two ears. In this group, there was a more or less uniform depression throughout the entire tonal range. Partial gaps or depressions appeared at any part. Thirty-eight ears

9. Bunch, C. C.: J. Laryngol. & Otol. **41**:565 (Sept.) 1926.

gave curves of the combined type. These were characterized by the presence of two islands with a gap between, which usually appeared for tones near 1,500 double vibrations. The curves for the two ears were not always similar; in fact, more were dissimilar than similar.

### PREGNANCY AND OTOSCLEROSIS

Burger [10] reports a case in which pregnancy was interrupted on account of otosclerosis. A patient in the sixth week of pregancy was found to have a severe degree of deafness with strong subjective noises. The symptoms had developed within three weeks. There was a hereditary tendency to otosclerosis in the patient's family, and this was regarded as the cause of the ear symptoms. In order to preserve the hearing of the patient, who was musical, abortion was performed. Burger recommends sterilization of such patients at the same time to prevent any future pregnancies.

### TINNITUS AURIUM

In a study of subjective ear noises, Kerekes [11] states that he has found evidence of a reflex from the mucous membrane of the middle ear. When the promontory on a certain spot in an ear with a large perforation was carefully touched, the noises were heard particularly strongly. When another spot was touched, another noise was heard, and in others the noise stopped. Application of cocaine to the area inhibited the production of the sound sensation or at least lessened it considerably. Epinephrine had no influence on it. The author also describes several cases in which a connection between head noises and the nasal mucous membrane could be proved. He also shows that stimulation of the mucous membrane of the middle ear produces a change in blood pressure. He treats these patients with sodium nitrite subcutaneously, and he claims to have had 12.7 per cent cured, 63.6 per cent improved and 36.4 per cent. unchanged. There was an improvement in hearing in 41.8 per cent.

### INNER EAR DEAFNESS

Germán [12] reports the results of further researches on the relationship of excess of uric acid in the blood to nerve deafness. Sixty-eight further carefully selected cases have been investigated, forty-one of which showed hyperuricemia, i. e., uric acid in the blood was more than 3.5 per cent. Of these forty-one patients, thirty-five underwent treatment, as a result of which the uric acid diminished in twenty-eight. Of the latter, nineteen showed improvement in the ear symptoms, which

10. Burger, H.: Acta otolaryngol. **7,** no. 2, 1925.
11. Kerekes: Passow-Schaefer's Beitr. **22,** nos. 5-6.
12. Germán: Verhandl. Gesellsch. deutsch. Hals-Nasen-u. Ohren-aerzte, München, Zentralbl. f. Ohrenh. **25**:103 (May) 1925.

were lasting in some and temporary in others. A drop in the blood uric acid is essential before improvement takes place in the ear symptoms, but the improvement in the latter does not always follow the lowering of the blood uric acid. Treatment consists of a purin-free diet along with the administration of cinchophen.

Germán divides the cases into four groups: 1. There was no improvement in the blood uric acid percentage and no improvement in the ear symptoms in this group. 2. With a purin-free diet and medication, there was a lasting improvement in the blood picture in this group. Of twelve cases, the ear symptoms were improved in eight for a long period, and in a few cases they were even cured. 3. In this group, there was a transitory fall in the blood uric acid followed by a rise, which was later controlled by energetic treatment. In the majority of these cases, i. e., in seven out of twelve, there was an exact parallel between the fall and rise of the uric acid and the improvement or otherwise of the ear symptoms. 4. In the last group, the uric acid was within high normal limits, but on theoretical grounds an abnormal susceptibility might be postulated. It was difficult to lower the uric acid in these cases, but when this was successful, an improvement in the hearing and tinnitus occurred.

In the refractory cases, probably the ear had been irreparably damaged, or the nerve deafness and the hyperuricemia may have been merely coincidental and independent.

Writing on the same subject, Berberich [13] reports somewhat similar observations. He discusses the metabolism of uric acid in general and points out that there are two sources, endogenous and exogenous. The exogenous source is dependent on diet, while the endogenous source is derived from the purin base in the tissues, etc., formed by the breaking down of nuclein. Gout is generally encountered for the first time in patients between 40 and 50 years of age and greatly preponderates in males. Certain hereditary factors enter into its occurrence associated with prolonged overnourishment with too little exercise. Other toxic substances, such as alcohol and lead, also have an influence on it. Germán and Kelemen, in an earlier paper, have stated that there is often no other sign of gout than the deafness and the hyperuricemia. In the last two years, Berberich has studied the blood chemistry in 300 cases, including ostosclerosis, nerve deafness from various causes, senile deafness and cases presenting the Menière syndrome. Out of all these cases, after careful hearing tests and the elimination of all other etiologic factors, there were only thirty of pure nerve deafness associated with hyperuricemia. Of these, from thirty-six to thirty-eight were combined with senile deafness. Berberich states that it is possible to differentiate

13. Berberich: Arch. f. Ohren-, Nasen-u. Kehlkopfheilk, August, 1926, vol. 115.

clearly between senile and nerve deafness. This is treated in another paper which will be abstracted also. In only from 8 to 10 per cent of the cases of nerve deafness was there a gouty basis. Elimination of the combined group left from 6 to 8 per cent that were due to disturbance of uric acid metabolism. The patients examined were taken from the hospital clinic, where gouty tendencies are not at all common. In the well-to-do classes, the figures would probably be much higher. Berberich comments on the high percentage (42 per cent) of gouty cases found by Germán and Kelemen in Budapest.

The technic of the examination was as follows: The patients were put for four days on a purin-free diet. The blood was removed after fasting on the fifth day. The uric acid in the serum was estimated by the Folin-Neubauer method. Control tests were made, and a number of patients were examined simultaneously. In all of Berberich's cases, the blood calcium and cholesterin were also estimated. In a third of the cases the blood sugar, total nitrogen, residual nitrogen, urea nitrogen, urea and indican were estimated as well.

The normal uric acid content of the blood is from 2 to 4 per cent, with a maximum of 4 per cent. All patients showing more than 4 per cent are classed as hyperuricemic if the kidneys have been found to be functioning normally. In the series of Berberich, the titer varied from 5.5 to 6.72 per cent.

Of the thirty patients, twenty-four were male and six female. All were between the ages of 42 and 59. Thus, age and sex correspond with those of persons with true gout. The other chemical substances estimated were all normal in the series. From 60 to 70 per cent of the cases of otosclerosis showed uric acid either within the low normal limits or definitely subnormal; that is, from 0.8 to 2.3 per cent. There was a parallelism with calcium and cholesterol. Cases presenting the Menière syndrome showed no alterations of the blood uric acid.

In these cases, hearing for whispered sounds was greatly diminished. The high tones were those most affected. Bone conduction was shortened, though not so markedly as in syphilis. The lower tones were more or less normal, but the upper tone limit was distinctly lowered. Subjective noises were disturbing in most cases. The vestibular apparatus was seldom affected either subjectively or objectively.

Treatment consists of putting the patient on a purin-free diet. In addition, cinchophen is administered in doses of from 0.5 to 1 Gm. three times daily, or neocinchophen 1 cc. hypodermically three times weekly. Cinchophen must not be used for too long a period. It should be used for four or five days and stopped for an equal period before it is continued. It is advisable to give sodium bicarbonate or magnesia along with the cinchophen to avoid digestive disturbances. Berberich had obtained satisfactory results with this treatment, the tinnitus disap-

pearing and the hearing improving. The blood uric acid dropped by about 0.5 to 1 or 2 per cent. Berberich has observed that the hearing distance for a whisper improved by from 2 to 3 meters. Some patients, however, did not improve with regard to either the blood uric acid or the hearing.

### SENILE DEAFNESS

In another communication on senile deafness, Berberich [14] brings some new facts to light. In the study of this condition, syphilis, autointoxication, gout, and tumor must be excluded. Besides the typical results of functional tests, Berberich lays stress in diagnosis on the presence of an arcus lipoides of the drumhead. He states that this always is present and is accompanied by an arcus lipoides of the cornea. The two appearances are always associated with an excess of cholesterin in the blood. In presbyacusis, there is also always an excess of cholesterin in the blood.

According to Westphal, arteriosclerosis and hypertonus are associated with hypercholesterinemia in 89 per cent, and there is great probability that this is the causal factor. With this in mind, Berberich tested the blood pressure in all of his cases of senile deafness and found that in more than 50 per cent there was a definite hypertonus which reached up to 210 mm. of mercury. The hypertonus was found especially in those showing early symptoms of deafness, that is, in patients comparatively young. This condition is often accompanied by dizziness, pressure of blood in the head, subjective noises and other symptoms. Vestibular tests do not show a definite deviation from the normal.

In diagnosis, therefore, the arcus lipoides of the cornea and drumhead and the estimation of blood pressure are important, as well as the estimation of the cholesterin content of the blood.

In treatment, Berberich advises concentration on an attempt to lessen the cholesterin content of the blood and the hypertonus. Calcium theobromin salicylate is given in doses of 1 tablet of 0.5 Gm. three times daily and is continued for from three to four weeks. In Berberich's series, in the less severe cases there was a rapid disappearance of the tinnitus and dizziness along with the general improvement. The blood pressure became slightly lowered, and above all the hearing became improved, sometimes to a striking degree. In the more severe cases, the treatment must be repeated at intervals or be started with double doses. Even in these, an improvement may be expected. In more severe cases, Berberich has used potassium iodide theobromin salicylate with good results. A second drug, namely, a thiocyanate preparation, rhodan, gave good results.

14. Berberich: Verhandl. Gesellsch. deutsch. Hals-Nasen-u. Ohren-aerzte, Hamburg, May, 1926, p. 155.

### NERVE DEAFNESS

Emerson [15] contributes a paper based on the study of 100 consecutive cases of nerve deafness. The results of his analysis show the importance of focal infection as a factor in the etiology of nerve deafness. Of the hundred cases, there were forty-seven of bilateral nerve deafness in which the middle ear was normal; twenty-two showing the effects of old suppuration of the middle ear, and the rest were miscellaneous. The etiology of the different types was believed to be as follows: otosclerosis, 1; whooping cough, 1; teeth, 2; sinuses, 2; measles, 2; boiler-maker's deafness, 2; grip, 3, and chronic tonsillitis, 22. These patients all dated the onset of their deafness from an attack of grip, tonsillitis, or some definite infection.

Among Emerson's conclusions are:

Tone perception is first lost in that part of the scale represented by the whispered voice, and the patient is quite deaf before the low limits are permanently raised, or, in other words, after the subsidence of an acute tubo-tympanic catarrh the patient is quite deaf before the tube is again a factor.

In all chronic cases of middle ear deafness the loss of tone perception tends to become the same for both ears.

The loss in bone conduction is common to all chronic forms of middle ear disease and is only a step in the loss of tone perception.

The same type of hearing tests with identically the same loss of tone perception in proportion to its chronicity is seen in nerve deafness without involvement of the conduction apparatus.

Most cases of chronic deafness of all types will improve if tone perception for the whispered voice is not below 6/25, if there is not lowered bone conduction.

All types of deafness are prone to relapse with recurring infections.

### MENIÈRE'S SYNDROME

Daland [16] reports an interesting case of Menière's syndrome due to focal infection. A man, aged 64, had suffered with attacks of severe dizziness at intervals for two years. Mild attacks of vertigo could always be induced by turning the head sharply to the right, or by assuming a horizontal position suddenly. There were marked subjective noises in the head.

A slight lymphocytosis was present and the patient was in a poor general condition. He had never had tonsillitis. The tonsils were atrophic and contained pus, from which a vaccine was made. They were removed, and subsequent to the operation the dizziness induced by sudden movements of the head immediately disappeared. No other treatment was adopted except an autogenous vaccine and small doses of sodium iodide. The lymphocytosis also cleared up shortly after the operation.

15. Emerson, F. P.: Ann. Otol., Rhin. & Laryng. **35**:1098 (Dec.) 1926.
16. Daland: Laryngoscope **36**:345 (May) 1926.

### NEUROLABYRINTHITIS AND SYPHILIS

MacKenzie [17] reports in detail a case of neurolabyrinthitis caused by a focal infection in which the Wassermann reaction was four plus. A man, aged 52, had had some dizziness for three weeks, which at first was not severe but which gradually became worse. He noticed that the dizziness was worse on turning the head to the left. There was slight incoordination of the movements of the legs. The ear felt blocked, and there was some impairment of hearing. Hearing tests showed a perceptive deafness in the left ear with the Weber test referred to the good ear and diminution of hearing for all tones. Vestibular tests showed a nonreacting labyrinth on the left side, i. e., absence of response to the caloric and galvanic reactions on that side and diminution of postrotary nystagmus.

Two etiologic factors were present, either of which could cause the neurolabyrinthitis; namely, syphilis and focal infection from pyorrhea and apical abscesses. In syphilis, the tendency is toward bilateral involvement, and therefore the author was inclined to accept focal infection as the cause. The patient was treated vigorously for syphilis without, however, altering the Wassermann reaction. Examination showed the blood to be characteristic of focal infection, with a leukocyte count ranging from 10,000 to 16,000, and with a small lymphocyte count ranging from 30 to 38 per cent. After treatment of the teeth, the blood picture improved in a striking way, followed by an improvement in the general condition as well as in the cessation of the vertigo and improvement in hearing. The vestibular nerve improved enough after a few months to react to the galvanic current but not to the other tests. The lack of improvement in the Wassermann reaction showed at least that in this case the focal infection was the cause rather than the syphilis.

Beck [18] has dealt with syphilitic conditions of the inner ear. As a text for his remarks, he reports the case of a soldier treated with arsphenamine sixteen years ago, with disappearance of the rash and other symptoms. Five weeks later, dizziness, vomiting and disturbance of equilibrium were present. The next day there was double vision, and two days later, facial paralysis. There was complete deafness and destruction of the vestibular apparatus. Beck attributed the neuritis to too large doses of arsphenamine without previous mercurial treatment. He has examined 2,390 syphilitic patients, and 150, or 5.27 per cent, of these had ear trouble. Ninety-three of these cases were due to the syphilis and in sixteen, or 0.6 per cent, the middle ear was involved. In forty-four, or 1.8 per cent, the inner ear was involved when arsphenamine

17. MacKenzie, G. W.: Laryngoscope **36**:878 (Dec.) 1926.
18. Beck, O.: J. Laryngol. **41**:702 (Oct.) 1926.

had not been given, while in thirty-three, or 1.4 per cent, the inner ear was involved when arsphenamine had been given. Fourteen patients were affected in the secondary stage and two in the tertiary. The acoustic apparatus was affected in twenty-six, while the vestibular apparatus was affected in only seven.

When a patient with a syphilitic lesion of the skin receives too large a dose of arsphenamine, the rash becomes more marked, raised and edematous. It has been found that the spirochetes have been killed. This is known as the Herxheimer skin reaction. Beck believes that isolated vestibular destruction is a Herxheimer reaction in the nerve, which becomes compressed within its narrow bony canal. These patients generally recover.

Schmidt [19] also has noticed the frequency of conditions of the cranial nerves following the introduction of arsphenamine, and believes with Beck that they are caused by too rapid destruction of the spirochetes resulting in edema with compression of the nerves in their narrow bony canals. Treatment consists in not repeating the arsphenamine and in using mercury or bismuth instead.

Ferretti [20] contributes an article on neoarsphenamine in relation to the eighth nerve. In the literature, there is a great diversity of opinion as to the cause of lesions of the auditory or vestibular nerve following the use of arsphenamine or neoarsphenamine. One group of observers believes that the lesions are due to a direct toxic action of the drug on the nerve, while another group, headed by Ehrlich, denies that neoarsphenamine has any toxic action on the nerves and affirms that the lesions are due to the syphilis itself. Others, again, think that while neoarsphenamine is harmless to a healthy nerve, it might further injure one in which there are some neuritic changes. Another view is that the symptoms are due to insufficient treatment and that increased doses are indicated. It has been pointed out that lesions in the ears in the earlier stages of syphilis have been more frequent since the introduction of arsphenamine, while previously they were rare except in the tertiary stages.

Ferretti undertook some experimental work in 1924 to determine whether or not neoarsphenamine is toxic to the nerves. He administered the drug to rabbits in (1) light doses with prolonged administration; (2) heavy doses with prolonged administration; (3) light doses with a short period of treatment; (4) heavy doses for a short period of treatment, and (5) a single large dose. The drug was administered intravenously at six day intervals. The subsequent microscopic examination of the animal was made after killing by cutting the carotid. The labyrinths were prepared by Wittmaack's method, and the brain stem

19. Schmidt, F.: Ztschr. f. Laryngol. **13,** nos. 1-2.
20. Ferretti, C.: Arch. ital. di otol. **37**:605 (Nov.) 1926.

was examined separately. In all, seven rabbits were used, and in none of these was there any symptom of damage to the auditory or vestibular apparatus. Histologic examination revealed nothing abnormal. The result of this piece of work, therefore, is that nothing has been discovered to confirm the idea of a specifically toxic action of neoarsphenamine on the auditory or vestibular apparatus.

### ACOUSTIC NEURITIS AFTER SCOPOLAMINE-PROCAINE INTOXICATION

Beeger [21] describes for the first time in the literature a case of acoustic neuritis after the administration of scopolamine-procaine. For a gynecological operation, a woman was given morphine and scopolamine and a sacral anesthesia with procaine. Immediately afterward, the breathing ceased and the patient went into deep coma. Next day there was paralysis of the lower extremities, and great dimness of vision with complete deafness for speech on both sides. Bone conduction was greatly shortened, and both upper and lower tone limits were impaired. In the course of three months, the hearing gradually improved for high tones. Later, perception of the lower tones returned. Bone conduction, however, remained shortened, and there was marked tinnitus. The Wassermann reaction was negative. Vestibular tests on the first day gave some slight diminution of excitability, which was attributed to somnolence of the patient. The case resolved itself into a condition of the cochlear nerve.

### DEAFNESS FOLLOWING TREATMENT WITH RADIUM

Moeller [22] reports a case of one-sided deafness after treatment. A man, aged 74, became deaf in the right ear after radium treatment of a carcinoma of the left side of the nose. At first, the vestibular nerve was also affected and showed a negative reaction to the turning test. The patient recovered from this, but the cochlear nerve remained permanently damaged. As the first symptoms were malaise and giddiness, the author believes that an edema of the meninges and labyrinth had been produced by the radium. Slight meningitic symptoms are not uncommon after radium treatment of the head. The patient had heard well before the treatment, and since no other reason for the deafness was discovered, the author believes the foregoing to be the explanation.

### PATHOLOGY

Steurer [23] describes minutely the pathologic changes found in a case of deaf-mutism. He states that no case of such complete destruction of

21. Beeger: Passow-Schaefer's Beitr. **22,** nos. 5-6.
22. Moeller, J.: Arch. internat. de laryngol., November, 1926.
23. Steurer: Ztschr. f. Hals-, Nasen- u. Ohrenh. **11,** no. 3, 1925.

the labyrinth with complete healing has been described previously. The destruction evidently had occurred early in life, and there was complete ossification of the cochlea and semicircular canals on both sides. The vestibule did not show quite so complete a bone formation. An interesting point is that in the vestibule numerous nerves fibers could be seen ramifying in various directions, and some of these could be traced from the facial nerve.

Haike,[24] writing on the formation of new nerve fibers in the vestibule and semicircular canals, notes that these are never seen in the cochlea but only in the vestibule. Brock had attributed this to a naturally greater resisting power in the vestibular nerve, but Haike doubts if that is the explanation. He points out that in a destructive labyrinth process the cells of the spiral ganglion are destroyed with the other structures, while the vestibular ganglion escapes, owing to its position in the internal auditory meatus, where it is not in immediate contact with the septic process in the labyrinth. The cells are therefore able to make some attempt at nerve regeneration.

Nager [25] reports the pathologic examinations in two cases of familial hereditary deafness in which functional tests had been carried out during life. These showed the complex of inner ear deafness. Histologic examination in the first case showed an underdevelopment of the cochlea, with reduction in the number of coils. In the second case, the picture was that of the so-called Mondini type, with dilatation of the cochlear canal and the saccus endolymphaticus, and atrophy of the sense cells. Both cases showed definite traces of hearing. In both there was a reduction of the lower tones, and this corresponded with the defect at the apex of the cochlea.

In a paper read before the American Academy of Ophthalmology and Otolaryngology, Nager [26] also gives a resumé of the whole subject of deaf mutism. In endemic cretinic deaf-mutism, the medial tympanic wall is mainly affected. There is a marked hyperostosis of the promontory with a narrowing of the window niches and adhesions of the deformed stapes. In the cochlea, a small hyaline body is found embedded between Corti's organ and the membrana tectoria. This is peculiar to endemic deaf-mutism.

In sporadic deaf-mutism, on the other hand, the changes are exclusively in the labyrinth and usually in both ears. In this type, there are three groups subdivided according to their severity. Complete absence of the cochlea (group *A*) is exceeding rare. Slighter changes confined to the neuro-epithelium of the cochlea or anomalies of the saccule are

24. Haike: Ztschr. f. Hals-, Nasen- u. Ohrenh. **11,** no. 2, 1925.
25. Nager, F. R.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **11,** no. 2, 1925.
26. Nager, F. R.: Laryngoscope **36:**313 (May) 1926.

not uncommon (group *B*). In the third, and by far the most numerous group (*C*), are included 70 per cent of the sporadic congenital deaf-mutes who have some remnant of hearing. In this group, there is a sacculocochlear degeneration varying in degree and with sometimes a defective modiolus and a large dilatation of the saccus endolymphaticus (type Mondini). It is interesting to note that in a number of these cases the bony labyrinth wall contains spots of otosclerosis. Otosclerotic persons not infrequently show slight malformations.

### TREATMENT BY THE ROENTGEN RAY

Smyth [27] has collected reports of ninety-six cases of progressive deafness associated with enlargement of the pharyngeal lymphoid granules, in which he has used the roentgen ray to determine what improvement, if any, resulted. The technic was that used by D. C. Jarvis and was described in the transactions of the American Trilogical Society in 1923. There were sixty-seven cases of chronic catarrh of the middle ear, eleven of recurring acute catarrh of the middle ear, and eleven resulting from otitis media, two of nerve deafness, and five of tinnitus without deafness. The greatest improvement was found in chronic catarrh of the middle ear and the next greatest improvement in recurring catarrhal otitis media. The subjective improvement corresponded closely with the objective improvement; namely, 25 and 22 per cent, respectively. In the cases of tinnitus, twenty-two patients, or 41 per cent, said that they were improved. Of the patients in whom improvement had taken place, none had had the impairment of hearing more than four years and most of them had had it less than two years. Smyth concludes:

1. Treatment of enlarged lateral bands of lymphoid tissue in the nasopharynx by X Ray seems to be an aid in cases of deafness or tinnitus of short duration.
2. In cases of recurring acute tubal deafness it seems to be a decided aid.
3. Deafness of long standing (10-15 years) showed no improvement in any of the cases treated.
4. The majority of patients improved were young, from 8 to 15 years.
5. There seemed to be no relation between improvement of the hearing and tinnitus and the macroscopic appearance of the pharynx. Some of the cases showing most improvement of hearing showed no macroscopic change in the pharynx and vice versa. Some cases in which the throat cleared up nicely showed no improvement in hearing.

Amersbach and Wucherpfennig [28] describe in detail a method of irradiating the eustachian tube in its long axis. They claim good results, which they attribute to the lessening of secretion in the tube, as well as to a quieting of the inflammatory changes.

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27. Smyth, Campbell: Ann. Otol. Rhin. & Laryng. **35**:1157 (Dec.) 1926.
28. Amersbach and Wucherpfennig: Verhandl. Gesellsch. deutsch. Hals-Nasen-u. Ohren-aertze, München, Zentralbl. f. Ohrenh. **25**:95, 1925.

### TREATMENT BY LIGHT

Kragh [29] has experimented with light therapy in thirty patients. He quotes Cemach as having obtained an improvement in 20 per cent of cases of chronic adhesive catarrh. The results of light treatment were better. Kragh used mercury quartz lamps, the Finsen-Reyn lamp, the carbon arc and the sollux lamp. Chronic catarrh of the middle ear was favorably influenced in only one of three cases. There was a more or less definite progress in seven of fifteen cases of otosclerosis. Irradiation had no effect in otitis interna. Unpleasant results were found in three patients; two had increased tinnitus and one dizziness and headache.

### INSTRUMENTAL TREATMENT OF THE EUSTACHIAN TUBE

With regard to local treatment of the eustachian tube in chronic catarrh of the middle ear, Grant [30] recommends the use of the Weber Liel catheter in obstinate cases of tubal obstruction. He first uses a large silver catheter and injects a drop of liquid petrolatum, after which he introduces a hollow gum-elastic Weber Liel catheter and inflates the ear. Many ears that will not inflate properly with ordinary catherterization will yield to this method. The flexible inner catheter will find its way along a sinuous tube in the same way as a bougie, with the additional advantage that it is safer as it can be checked by inflation and auscultation to make sure it is in the proper place.

Duel [31] recapitulates his views on the use of the eustachian bougie. He states that the tubal mechanism is a delicate one and that the gentlest passage of a bougie is inclined to cause some trauma. He therefore uses a bougie only in subacute catarrh of the middle ear in which there is long continued swelling and in which all other local measures have been attended to. In these cases there is a marked improvement on inflation, which is, however, only temporary.

The technic is as follows:

> After the mouth of the tube is cocainized and sterilized with colloidal silver, a small whalebone bougie which has been bathed in colloidal silver is introduced. This is repeated in a few days with a larger size. Occasionally, when there is an obstruction that cannot be overcome without undue pressure, the gold tipped galvanic bougie is used through an insulated catheter. This method will succeed when all else has failed, but is suitable only in such cases, as its use is tedious and consumes a great deal of time.

### TREATMENT BY DRUGS

With regard to the treatment of noises in the head, Sacher [32] recommends a method of treatment by mercuric chloride, which has been in

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29. Kragh, J.: Ztschr. f. Laryngol. **14,** no. 3.
30. Grant, Dundas: J. Laryngol. & Otol. **41**:732 (Nov.) 1926.
31. Duel, A. B.: Local Treatment of Eustachian Tube, with Special Reference to Present Status of Bougie, Arch. Otolaryng. **4**:196 (Sept.) 1926.
32. Sacher, A.: Zentralbl. f. Ohrenh. **25**:247, 1925.

use for more than forty years in the Maximilian Institute in Petrograd. He has collected reports of 256 cases occurring over a period of twenty-five years. All cases were thoroughly investigated. There were 165 cases of ostosclerosis, and 16 of nerve deafness; the rest were due to various causes, mostly chronic catarrh. Of the 256 cases, treatment with drugs was a decided success in 144, or 56 per cent; there was improvement in 54, or 21 per cent, and no effect in 58, or 23 per cent. Eight patients had syphilis, and in five of these treatment was successful. Sublimate has no effect on hearing. The different types of ear lesion responded approximately equally, and, considering the different pathologic conditions, Sacher concludes that the effect must be purely symptomatic and has no effect on the disease itself.

The sublimate is administered in the form of pills, each pill containing 1 mg. of mercuric chloride. One pill is taken twice daily after meals, and fifty are taken all together. Improvement, when it occurs, is noticed only at the end of the series, but is more marked during the administration of a second series. It is as well to inform the patient of this fact. The improvement usually lasts for from one-half to one year, after which resumption of the treatment is advised.

# Abstracts from Current Literature

## Ear

ACUTE OTITIS MEDIA CAUSED BY MICROCOCCUS TETRAGENUS. STEFAN KREPUSKA, Ztschr. f. Hals-, Nasen- u. Ohrenh. **16**:553 (Nov. 8) 1926.

Zaufal, Pirodda Maffeo and Hudson reported cases of otitis in which *Micrococcus tetragenus* was the only cause of the disease. In 1922 Germán examined bacteriologically, in the University Ear Clinic in Budapest the blood of forty-three patients suffering from otogenous sepsis. In one patient he found the staphylococcus and *Micrococcus tetragenus*. The patient recovered in spite of a pyemia which lasted for one month after the operation and which was accompanied by daily chills. Autovaccine was used. In the patient whose case was reported by Krepuska, *Micrococcus tetragenus* was the only cause. It caused a grave disease of the tympanic cavity, a retention with a large fibrinous mass and an osteomyelitis of the mastoid process which destroyed the bone, exhibiting a perisinous abscess within nineteen days. The patient recovered with good hearing.

ARTIFICIAL PERFORATION OF THE DRUM MEMBRANE TO IMPROVE HEARING: A NEW METHOD TO CREATE A PERSISTENT PERFORATION. M. SCHIRMUNSKY, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:97 (Dec. 18) 1926.

In the seventeenth century, Riolan recommended excision of a part of the membrane of the drum in order to cure hardness of hearing. The author mentions the subsequent efforts of many others to create a permanent opening in this membrane by partial resection, without success. In forty-seven patients suffering from otosclerosis, Lucae excised the whole membrane of the drum and removed the hammer and anvil fifty-three times. In twenty-eight cases improvement of hearing was noticed; in twenty-one the defect in the membrane remained permanent. In 1890 Schirmunsky reported a new method to create a permanent perforation of the membrane of the drum. The quadrant of the membrane chosen for perforation is touched repeatedly with a 10 per cent cocaine solution. (Later, the author mentions the use of a 20 per cent cocaine solution with a little epinephrine). The membrane of the drum is then incised with an ordinary paracentesis knife, vertically or by cross-cuts. After the wound has become dry, the edges of the cut are touched with crystals of chromic acid fused to the end of a silver probe. Care must be taken not to touch the mucous membrane of the promontorium. The reaction of the membrane of the drum is insignificant. There is little pain, and it is of short duration.

The author employed the artificial perforation in a large number of cases with success. Eleven cases were observed for from two to ten years. The anatomic histologic observations of Zuckerkandl led the author to choose a spot at the umbo of the handle of the hammer where the circular fibers are absent and where the lamina propria shows only radial fibers. The object of artificial perforation is to allow sound waves to go directly to the labyrinth in cases in which the sound conduction from the membrane of the drum to the stapes is interfered with. Of the five indications of Politzer, the author considers chiefly the first two: (1) abnormal thickening and calcifica-

tion of the membrane of the drum, and (2) fixation of the hammer and anvil to the walls of the tympanic cavity, either directly or by adhesions.

The noises are usually affected favorably.

The author reports eleven cases. Myringotomy was performed in order to improve the hearing, usually in patients who had become hard of hearing in consequence of suppuration of the middle ear.

PECULIARITIES AND POSSIBILITIES OF SURGICAL REMOVAL OF NEUROMAS OF THE ACOUSTIC NERVE. E. HEYMANN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:109 (Dec. 18) 1926.

Heymann enters thoroughly into the discussion of the characteristics of these tumors. Of sixteen patients operated on, seven (43.7 per cent) lived. In 1923 four patients lived; in 1925 the four patients died because the author thought that the tumors were benign, and left parts of them at the anterior portion of the pons. He also states that he operated according to the imperfect method of Cushing. Death always resulted from respiratory paralysis. The author strongly recommends the occipital route and decries the translabyrinthian method, for various reasons. He lays great stress on the fact that, next to prevention of hemorrhage, the greatest possible care and delicacy during the operation is the supreme law in extirpation of tumors. Even change of position, change of beds, transportation from one house to another may result in death. Also touching the tumors or the surface of the brain, the puncture of the brain or of the ventricle with a fine hollow needle, or a slight hemorrhage may suddenly change the pressure in the brain of the patient suffering from a tumor of the brain, so that death may ensue.

Paralysis of the vessels occurs, the brain swells, and paralysis of respiration and of the heart set in.

TONUS INDUCTION IN THE OTOLITH APPARATUS. F. LEIRI, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:127 (Dec. 18) 1926.

The author states that he intends to prove that extension contractions in the extremities during movements of falling (attitude of readiness to jump) cannot be excited from the semicircular canals, as Magnus and DeKleijn assume, but that they seem to be set in action by the maculae. This applies also to extension contractions during vertical movements (elevator movements). This occurs also in animals with dislocated otolith membranes because the pressure of endolymph on the epithelium of the maculae ceases during falling. This investigation proves that tonus is excited in the muscle system of the body during falling by the otolith apparatus. It may be that the membranes of the otoliths are of secondary importance for the tonus-producing function of the maculae acusticae. The great decrease in pressure of the endolymph on the epithelium of the maculae which occurs during falling is sufficient to excite tonus of the muscles of the body without the otoliths. Yet the latter are absolutely necessary to excite the finer reactions which depend on the various positions of the head (position reflexes), because the otoliths magnify the differences which the various positions excite in the pressure on the epithelium of the maculae.

THE SEPTUM PETROSQUAMOSUM (MASTOIDEUM) AND ITS CLINICAL SIGNIFICANCE. O. KOERNER, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:137 (Jan. 31) 1926.

During the development and growth of the mastoid process, the cell system emanating from the antrum squamosum remains separated from the cell system

emanating from the antrum petrosum by a bony wall, which may persist into later life. This wall was named "septum mastoideum" by H. J. Wolff. Koerner thinks that the name "septum petrosquamosum" is better. So far only four temporal bones of this nature have been described by Frey, Bruehl, the author and Wolff. Aeby and Wildermuth have shown the septum in frontal cuts, and Wolff has shown it in a horizontal cut. Koerner depicts a specimen on which the lamina vitrea of the sulcus transversus is also laid bare. A well preserved septum may be taken for the osseous covering of a protruding sinus transversus. This septum explains why there are sometimes more or less isolated diseases in the region of the petrosal cells or of the squamous cells. Two separate foci may be present — one in the antrum, the other in the cells of the tip of the mastoid. These may be separated by healthy cells. The fistular path connecting these two foci is in the region of the petrosal cells, and is covered outwardly by the septum and the squamous cells. This deep-seated fistular path is found by placing the spoon-shaped end of the small rongeur into the antrum and the other in the focus at the tip, and removing the bone situated between the two. If the antrum is opened first, a deep furrow must be chiseled from the floor of the antrum to the tip in order to uncover this path. Such a furrow should also be made in mastoiditis without perforation at the tip, so that a latent disease of the tip will not be overlooked.

These conditions explain why a Bezold mastoiditis almost never occurs in small children. It is noteworthy that the pneumatic system of the mastoid has been known for fifty years and that the importance of this septum in operations, has not been recognized. Rightly Claude Bernard states: "Nous sommes entourés des phénomènes que nous ne voyons pas." (We are surrounded by phenomena which we do not see.)

Subacute Mastoiditis Through Mixed Infection with the Bacillus Pyocyaneus and Streptococcus (Synergism of the Bacillus Pyocyaneus and the Streptococcus Anhemoliticus in Animal Experiments). Erich Wirth, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:188 (Jan. 31) 1927.

The author reports a case in which the patient recovered. Experiments were made with mice, and the following conclusions were reported. *Streptococcus anhemolyticus* is slightly pathogenic for man, but not at all for mice. *Bacillus pyocyaneus* is scarcely pathogenic for man, and only slightly pathogenic for mice, depending on its virulence. The mixed infection, however, led to mastoiditis in man, and to fatal sepsis in the mouse. *Bacillus pyocyaneus* lent invasive qualities to the anhemolytic streptococcus in the experiment with animals. It may be assumed that the same holds good for mastoiditis. It is not improbable that *Bacillus pyocyaneus* may possess this quality in conjunction with other microbes causing otitis media.

Amberg, Detroit.

## Pharynx

Postanginous Pyemia. Johannes Zange, Ztschr. f. Hals-, Nasen- u. Ohrnhe. **17**:141 (Jan. 31) 1927.

Postanginous pyemia is about the most dangerous complication of tonsillitis. It frequently develops after a peritonsillar abscess or a retrotonsillar phlegmon. As a rule, primary thrombophlebitis of the tonsillar veins is present, with or without propagation of retrotonsillar thrombophlebitis to the jugular vein. Occasionally, the cause of primary thrombophlebitis of the jugular vein is

found in the lymph channels. In scarlet fever, as a rule, the cause of thrombophlebitis of the jugular vein is found in the lymph vessels and glands of the neck. Thrombophlebitis may also extend to the cranium. Aerobic microbes, streptococci, diplococci and staphylococci, especially anaerobic microbes, above all, *Streptococcus putrificus* and other bacilli not specially known, can be accused. Most dangerous are the anaerobic bacilli which cause metastases in the lungs and lead to death in from eight to fourteen days.

The diagnosis may be difficult. As a rule, the treatment has consisted of ligation of the internal jugular vein, or of evacuation of its contents, incision of a peritonsillar abscess by way of the mouth or circumcision of the diseased tonsil under conduction anesthesia of the plexus cervicalis according to Kulenkampf, in a half elevated position. The afferent veins of the jugular vein, especially those from the posterior layer of the tonsil, must also be included in the operation. If possible, the patient should receive for one or two days cardiac stimulants, such as digitalis, and one or two hours before the operation, 20 cc. of glucose (50 per cent) intravenously. The principal rules for the treatment of the grave forms of postanginous pyemia are:

(1) Early intervention.

(2) The original focus of infection and the thrombophlebitis originating therefrom should be attacked extensively and thoroughly behind the tonsil. This should be done by primary enuclation of the tonsil, by exposure elimination and evacuation, and, if possible, by extirpation of the diseased vessels from the outside reaching to the region immediately behind the tonsil. Simultaneously, free foci of pus should be opened and drained.

(3) The intervention should be confined to thrombophlebitic vessels, and great care should be taken to prevent further extension of the process by eventual double ligation and by ligating all connections with the healthy vessels.

(4) Essentially the same course should be followed in lymphadenogenous thrombosis of the jugular vein. Besides enucleation of the tonsil and elimination of the jugular vein, the glands should be extirpated. The region behind the tonsil need not be touched if the thrombosis is confined to the jugular vein or if there is no likelihood of the presence of a hidden focus in that region.

(5) The whole procedure should be carried out under local anesthesia, if possible.

The less severe cases demand only enucleation of the tonsil, sometimes only an incision of a peritonsillar abscess. In these cases a few chills may occur, which cease spontaneously. Metastases may occur in the joints, the muscles, the skin, the parotid, the ear, the orbit or even the lung. These may heal spontaneously, or may be aided by puncture or incision.

The author observed three grave cases in which all the patients died. In one of these, the patient, a student, was admitted in a dying condition. The patients in the author's three light cases recovered.

The first patient, a woman, aged 25, seemed acutely ill. The tonsils were swollen and coated, and profuse thin pus was evacuated by pressure. The glands were swollen on both sides of the neck. Hard tender cords traveled along the jugular vein. The joints of the shoulders and knees were slightly swollen and painful on motion. The smear from the tonsils showed streptococci. The blood was sterile. Chills had been present with a temperature reaching 105 F. one day. As the question arose whether there was thrombophlebitis of both jugular veins, and because no pronounced metastases existed, especially

in the lungs, during the prolonged course lasting fourteen days, only tonsillectomy was performed. This operation was successful.

The second patient, a man, aged 28, had suffered for two weeks from follicular tonsillitis which showed no outer signs. The general condition became worse, the color of the skin became grayish-yellow. The joint of the left knee and the wrist were painfully swollen. All symptoms disappeared after bilateral tonsillectomy. The patient was cured.

The third patient, a man, aged 34, suffered from a deep peritonsillar abscess on the left side. After the abscess had been incised twice, releasing pus which contained anaerobic streptococci, the patient was discharged. Six days later the patient was readmitted. The right parotid was swollen, and a right acute perforative otitis media had set in during the previous two days following severe chills with temperature to 104 F. The neck was stiff, and other signs of meningeal irritation were present. The spinal fluid was normal. Pus from the ear contained anaerobic streptococci. The chills did not recur, except on the first day, and no signs of thrombophlebitis of the jugular vein were present. The temperature, which had been 102.2 F., had decreased by lysis after the fourth day. The primary focus in the region of the left tonsil appeared entirely cured. Therefore surgical intervention was not resorted to. Within three weeks the parotitis and otitis healed spontaneously.

The author describes briefly five cases found in the literature: one case reported by Haardt, two by C. Hirsch, one by Uffenorde and one by Weber.

FURTHER INVESTIGATION CONCERNING THE CHANGES IN THE LYMPH FOLLICLES IN ANGINA LACUNARIS. RICHARD WALDAPFEL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:217 (Jan. 31) 1927.

Lymph follicles are free from great quantities of leukocytes in all sections of clinically normal tonsils. At times scarcely a single leukocyte is found in a follicle. In tonsillitis a mass of leukocytes is found in most follicles a day after the clinical height of the disease. In only a few sections did such a focus communicate directly with the lacuna. These foci correspond in appearance and localization with those previously described by the author and Grossmann, in which they also demonstrated streptococci. At this stage, the epithelium is densely infiltrated with leukocytes, which in some places wander to the surface in masses. These cells are found in larger quantities only in the interfollicular tissue, which contains vessels, and in the so-called germinating center. During the next few days the picture becomes normal. Large cells appear in the follicles. They contain granules, which are apparently reticular cells, and seem to have absorbed leukocytes which have perished. In the period of convalescence leukocytes can be found only in the superficial layers of the epithelium. The deeper layers are free. The sections show a normal appearance again in less than a week after the disappearance of the clinical symptoms. The lymph follicles and their germinating centers are not exclusively places of production of lymphocytes.

AMBERG, Detroit.

## Larynx

PATHOLOGIC ANATOMIC INVESTIGATIONS OF TUBERCULOSIS OF THE LARYNX. A. ESCH, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:222 (Jan. 31) 1927.

The picture of fully developed tuberculosis of the larynx is well known, but little is known concerning its onset. If the possibility of the development by way of the blood or lymph current is disregarded, and only the usual mode—

infection of the mucous membrane of the larynx by the sputum — is considered, there are two theories which oppose each other. Some believe that the bacillus enters the tissue through small, superficial lesions of the epithelium of the mucous membrane caused by coughing; others believe that the bacillus enters the submucosa through the intact epithelium when lymph vessels are scarce and lymph movements are tardy.

Larynxes were taken from persons who had coughed a great deal during the last period of their lives on account of nonspecific diseases of the lungs.

Histologic examination of these larynxes gave a rather uniform picture. The epithelium was well preserved. The extent of squamous epithelium compared with that of cylindrical epithelium varied. The squamous epithelium may be on the vocal cords, the posterior wall and the aryepiglottic folds, or large areas of the false vocal cords may be covered with squamous epithelium. In some instances Esch found increased layer formation of squamous epithelium at the posterior wall. Small or large cones of squamous epithelium reached deep into the submucosa, which showed papillary structure in this region. Large nests of squamous epithelium were found in the submucosa of the posterior wall in a child, aged 5 months. These were ducts of glands which were lined with squamous epithelium near the surface. In other cases this epithelium was found for some distance in the dilated excretory ducts of glands, but it gave way abruptly to cubic epithelium. In many regions of the submucosa an infiltration of lymphocytes and isolated plasma cells were found. This infiltration was diffuse in some spots, and was grouped in others. These small groups of lymphocytes were not situated directly at the membrana propria, but somewhat deeper. A loosening of the submucous connective tissue and an increase in cells were found in isolated spots. In areas where the circumscribed groups of lymphocytes reached the epithelium, lymphocytes were found in all layers of the epithelium. They loosened the epithelium and separated isolated cells or groups of cells. The individual cells became turgid and vesicular. The nuclei could not be stained so well. In other places of the submucosa, lymph nodules with functioning centers were found. Here the epithelium was changed in the same manner. Pronounced infiltration of lymphocytes was encountered around the ducts of the glands and in the collections of glands in the submucosa and in the deeper layers. The cells of the glands were functioning well. In spots, the cells of the glands showed blurred borders and a poorly staining quality of the nucleus (beginning degeneration). Much secretion was found in the ducts of the glands. In some places the ducts of the glands were dilated on account of the accumulation of secretion. In the muscles the nuclei of the interstitial tissue were increased in numbers. The muscle fibers showed transverse striation.

Larynxes without macroscopic changes from patients with pulmonary tuberculosis were examined. The disease was of an exudative, necrotizing type and was the cause of death. In only one instance was the diagnosis doubtful.

Ten larynxes were examined. Only two were free from tuberculous changes. In one case, the mucous membrane of the larynx did not show any changes. In the other case, the changes found in the mucous membrane were the same as those reported in the first series examined. In the other eight patients, the larynxes showed histologically undoubted tuberculous changes. A detailed description of the microscopic observations is given, which should be read in the original. Solitary tubercles were found in the submucosa, directly beneath the epithelium as a rule. They consisted of a center of epithelioid cells with

single or several giant cells. The epithelium above these solitary tubercles was intact in some places; most of it was loosened by immigrated lymphocytes. The epithelium was missing in some areas. Conglomerated tubercles were rarely found. All these tuberculous changes were superficial, and extended deeper only in the region of the excretory ducts of the glands. A regularity of localization of tuberculous changes could not be established, yet a preferred part was the posterior portion of the recessus piriformis. In two instances the rest of the larynx was intact. The muscle system was always well preserved. In the interstitium an increase of nuclei was found in varying amounts. Around the tubercles, the muscles were pushed apart. Narrow bundles of fibers were found at the border. In these bundles transverse striation could not be seen. In eight of these cases there were no macroscopic changes, and yet the presence of tuberculosis could be shown with certainty microscopically. In one instance, the clinical diagnosis of "phonasthenia" was made. It is advisable to be careful in making such a diagnosis in the presence of tuberculosis of the lungs.

AMBERG, Detroit.

## Nose

RHINOLOGICAL FINDINGS AND TREATMENT OF CASES OF RETROBULBAR OPTIC NEURITIS. MARK J. GOTTLIEB, New York State J. Med. **26**:1011 (Dec. 15) 1926.

The author states that the rhinoscopic observations in cases of retrobulbar optic neuritis are practically of negligible value in establishing an etiologic relationship between the paranasal sinuses and the involvement of the optic nerve. Recent investigations have shown that as yet no definite criteria have been established by which a statement may be made on examining the interior of the nose, that the sinuses do or do not cause the existing diminution in vision.

The author has observed in his experience that cases have occurred in groups. He has had three or four cases within a few months, and then, except for sporadic cases, he would not have another series until a year or so later, and he raises the question as to whether retrobulbar optic neuritis from disease of the paranasal sinus of the nonsuppurative type is due to some form of bacterial infection which is as yet not understood.

He believes that the great majority of cases of retrobulbar optic neuritis are not associated with purulent infection of the sinuses, and it is this absence of discharge and other evidences of inflammatory reaction which characterizes this disease.

According to the author, the management of cases of retrobulbar optic neuritis may be divided into expectant and operative treatment. Unless haste is essential, he advises a complete physical examination, including a Wassermann test and roentgenograms of the nasal accessory sinuses and of the optic canals. Palliative treatment has not been practiced in this country as much as abroad.

Gottlieb states that the rational procedure for the palliative handling of cases of retrobulbar optic neuritis is to give the patient a brisk cathartic, shrink the turbinates with epinephrine and cocaine followed by suction. This may be supplemented by tampons containing some of the silver albuminate salt, and autogenous vaccines may be given. This management should be given in conjunction with an ophthalmologist who must see the patient daily.

The surgical treatment consists of a thorough removal of all possible ethmoid tissues and breaking down the anterior wall of the sphenoid cavity.

The author reports three cases, the first being that of a schoolgirl who complained of severe frontal headache, tenderness over both frontal sinuses and nasal discharge. At first she did not complain of difficulty with her vision. Ophthalmic examination showed that the patient was rapidly losing her sight. Roentgenograms showed no disease of the nasal accessory sinuses. A bilateral ethmosphenoidectomy was performed, and following the operation the headaches disappeared. Six weeks later the ophthalmologist reported a moderate improvement in the vision.

Directly after that, however, her vision again began to fail, and the question arose as to what procedure should be followed. A secondary operation was performed, consisting of removal of all scar tissue and both middle turbinates. This produced an immediate and progressive improvement in her vision, so that a month later it was found to be practically normal, and it had remained so for two years at the time of the report.

Gottlieb says that he has seen nine cases of retrobulbar optic neuritis, eight of which were bilateral and the other unilateral. The unilateral case was one in which, at some time previous, a piece of cotton had been accidentally left between the middle turbinate and the septum by another physician. On the day scheduled for operation, the patient sneezed out the cotton, and the optic neuritis promptly cleared up.

The second case reported was one in which the vision had rapidly failed from normal to counting fingers at six feet. Roentgen-ray examination gave negative results. At operation both ethmoids were opened. The right sphenoid was absent, and the left was shallow, but extended deep down into the pterygoid plate. The patient did not improve, and the vision became progressively worse. A Wassermann reaction was negative. Two abscessed teeth were removed. The eye became so much worse that the patient could only distinguish light, and then she suddenly improved and has continued to do so ever since.

The third case reported by the author was one in which the patient had had a thick purulent discharge from the nose for years with frequent colds, and recently had experienced difficulty in concentrating his vision, principally with the right eye. Mucopurulent material was seen dripping from the middle meatus on both sides, but more from the right. The right frontal sinus was cloudy, and the left was clear on transillumination. There was tenderness over the right frontal and maxillary sinuses.

Examination of the eye showed, besides hyperopic astigmatism and presbyopia, that the fields were good for form, while the color fields were relatively contracted, the right more than the left.

A week later an ethmosphenoidectomy was performed. The sphenoid sinuses were found to be unusually low down, and in both instances extended deeply into the pterygoid plate. The right sphenoid was distinctly diseased. Three days after the operation, the patient experienced improvement in vision. This improvement continued for three months, when visual disturbances again began to be manifest. Four months later, examination showed an increased constriction in the fields, especially for form. Nasal examination showed an increase in the purulent discharge. Under local treatment to the nose and autogenous vaccine therapy, his vision improved up to the last time he was examined.

ROENTGEN-RAY FINDINGS OF OPTIC CANALS IN BLINDNESS DUE TO NASAL ACCESSORY SINUS DISEASE. HENRY K. TAYLOR, New York State J. Med. **26**:1015 (Dec. 15) 1926.

The author gives the anatomy of the optic canals and the average measurements according to Whitnall, Wilbrand, Saenger and Goalwin. Roentgenographically, the shadow cast by the canal is referred to as the optic foramen. In reality, this shadow is the narrowest portion of the canal. The question of technic is important, and the author gives his technic.

In conclusion he states that the roentgenographic appearance of the optic canal has a definite but limited value. The roentgen-ray observations establish only the urgent necessity for operative intervention to avert irreparable damage to the optic nerve. A contracted canal warrants early intervention. A canal of normal size does not necessarily require early intervention and permits of further study to determine the exact cause, which, at times, may not be due to a disease of the sinus.

VAIL, Cincinnati.

ENDONASAL TREATMENT OF AN ETHMOID-FRONTAL MUCOCELE. ROSSIER, Ann. d. mal. de l'oreille, du larynx **46**:49 (Jan.) 1927.

Rossier reports a case of a girl, aged 18, who had a swelling in the region of the internal angle of the left orbit, accompanied by diplopia and displacement of the eyeball to the left. There was a large bony protrusion in the region of the middle meatus. This protrusion was rounded and smooth, and touched the nasal septum. There was a normal mucosa, and no pus was present in the nose. The roentgenogram showed a mass uniformly clear in the region of the left frontal ethmoid. This mass was regularly rounded and encroached on the inferior and internal part of the frontal sinus. The diagnosis was a mucocele developing from the anterior ethmoid cells and spreading out to the inferior part of the frontal sinus.

An operation was performed under local anesthesia and consisted of resection of the septum, removal of the anterior two thirds of the left middle turbinate and opening up of the bony swelling endonasally with escape of a mucoid, slightly yellowish fluid. The frontal sinus was probed, and the entire region involved was cleaned out. The bony bulging at the orbital angle was reduced under ethyl chloride anesthesia by digital pressure. Six months later, there was an excellent result.

The author speaks of the endonasal route not being generally used in the treatment of mucoceles of the ethmoids. He states that the mucocele from the posterior ethmoids must be operated on by the external route. The pure frontal sinus mucoceles should be operated on either endonasally or externally, depending on the size of the cavity and the ease with which the mucocele can be reached. The anterior ethmoid mucocele should be operated on by the endonasal route. The principal indications are the ease with which the opening of the pouch through the nasal fossa can be made and the possibility of resetting the deformed orbital wall by simple external digital pressure.

ABSCESS OF THE FRONTAL LOBE OF SINUS ORIGIN. GEORGES PORTMANN and NOEL MOREAU, Rev. de laryngol. **1**:1 (Jan. 15) 1927; **2**:40 (Jan. 31) 1927; **3**:81 (Feb. 15) 1927.

Abscess of the frontal lobe of sinusoidal origin is the least frequent complication of suppurations of the pericranial cavities. The authors base their observations on many cases seen in the clinic both before and after operation.

They review at length the anatomy of the sinuses, pathology, etiology and symptomatology of abscess of the brain in general, and those of sinus origin in particular. They also give in detail their method of treatment. They summarize the study as follows:

Abscess of the frontal lobe following suppuration of the frontal sinus, while not frequent, is not a clinical rarity. It may follow an acute sinusitis, or rather a common infection engrafted on a chronic recurring condition or resulting from trauma. The abscess, generally unique and of medium size, shows a subcortical preference, frequently co-existing with osseous lesions of the inferior and posterior wall of the sinus, purulent subpalpebral collection, extradural abscess and lesions of the dura mater.

The symptomatology of abscess of the frontal lobe is scant. The signs of intracranial hypertension are more often discrete, and the ocular symptoms in particular are absent in a large majority of cases. The symptoms of localization appear clearly when the rolandic region is invaded in the form of epilepsy, generalized paralysis or localized in one limb.

The diagnosis may be placed in the domain of the rhinologist, who may be responsible for the treatment of the frontal sinus. However, the circumstances may leave the responsibility with the ophthalmologist and rarely with the neurologist. Whoever it may be, the clinician should not wait for definite symptoms. The signs of presumption, pointing to an infection of the sinus, the aggravation of the general condition in spite of a previous intervention of the frontal sinus and the definite presence of more or less intracranial hypertension, should be sufficient to cause an investigation of the frontal lobe.

The treatment first consists of attention to the sinus. When the assurance has been given of the existence of an abscess by the exploratory puncture, recovery should rapidly follow the evacuation of pus. The postoperative difficulties of drainage may affect the prognosis, especially when the collection of pus is suddenly discovered. The uncertainty of diagnosis and the frequent misfortunes of treatment of abscess of the frontal lobe of sinus origin cause the specialist to take preventive measures. The interventions in the frontoethmoidal region are actually well regulated and the results favorable. Active treatment of old suppurations of the frontal lobe tends to commend itself more and more to the careful rhinologist.

ROTH, Kankakee, Ill.

LESIONS OF THE OPTIC NERVE DURING OPERATIONS IN THE NOSE AND THE ORBIT. HALLE, Monatschr. f. Ohrenh., no. 3, 1926 (translated from the abstract by Lautman, Ann. d. mal. de l'oreille, du larynx. **46**:91 [Jan.] 1927).

While the optic nerve easily endures trauma, compression and stretching, the retina is excessively sensitive. It does not support easily the deprivation of oxygen, and if the circulation is entirely suppressed for ten minutes, blindness can be considered as irremediable. During operations, especially when local anesthetics are used in the region of the ethmoid nerves, it sometimes happens that the patient says he cannot see with the eye on the side on which the operation is being performed. The chain of events almost always occurs in the same fashion. The three following observations illustrate it.

A patient received an injection of 1 cc. of 0.5 per cent solution of procaine hydrochloride and epinephrine in the left ethmoidal sinus, and almost immediately he declared he was blind on that side. An ophthalmologist examined the patient without finding the cause of blindness. Halle, consulted over the telephone, advised immediate intervention. The operation was stopped, and ten hours later Halle intervened but without success.

A rhinologist at Bonn opened the ethmoid, and caused a hemorrhage which obliged him to put in a tight packing. The eyelids swelled immediately, became blue, and the patient declared he was blind on that side. An ophthalmologist was not able to find the cause of the blindness.

At Halle's clinic, an assistant injected the infra-orbital nerve by the canine fossa. Immediately after injection the two eyelids swelled. The assistant studied the pupillary reaction, and found that the pupil did not react. The patient said she did not see anything on that side. They immediately called Halle, who, knowing the disastrous effect of the edema in the orbit compressing the retina, intervened without hesitation only a few minutes after the injection. He immediately made the incision of Killian, elevated the periosteum and periorbita as far as possible and split them. The next morning the edema had disappeared, and vision had returned.

The loss of vision resulting from endonasal interventions is certainly more frequent than the literature suggests. Without considering direct lesions to the optic nerve which are irremediable, one must, without hesitating, intervene by the procedure of Halle as soon as the patient says that blindness is present, and the surgeon finds immobility of the pupil. It is hazardous to hope that the toxic effect of the anesthetic will pass or to believe that the retina will resist in spite of the compression. Even if the edema of the eyelids is not distinct, one must be on guard against the possibility of hemorrhage into the retina. It is easy to liberate the retina from the compression by the incision of Halle. In that case one can also, to be more certain, remove the paper plate.

VAIL, Cincinnati.

ANOMALIES OF THE TEETH AND THEIR RELATION TO THE NOSE AND MAXILLARY ANTRUM. H. J. PETERMANN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:51 (Dec. 18) 1926.

The author reports two cases. The first patient, a girl, aged 18, suffered from headaches for a year. A specialist had treated the frontal sinus without success. A roentgenogram in the clinic in Breslau showed a wisdom tooth located just under the floor of the maxillary antrum. Denker's operation revealed a thick polypoid mucous membrane. The patient was cured.

Roentgenograms of the second patient, a woman, aged 56, showed two canine teeth near the apertura piriformis. They were situated obliquely from upward and outward, downward and inward. The patient was cured after having been operated on by Denker's method. The whole right maxillary antrum was filled with polyps and much pus. The retained tooth was no longer covered by bone in the rear, and the root was carious. It is possible that the process in the maxillary antrum had begun years before. It had started to destroy the anterior wall of the maxillary antrum and exposed the root of the tooth, which led to caries. The opposite might have taken place. The author cannot state with certainty that the chronic empyema was caused by the diseased tooth.

A NEW METHOD OF REMOVAL OF THE ANTERIOR ATRESIA OF THE NOSE. F. BOCKSTEIN, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:180 (Jan. 31) 1927.

Koerner removes the portion of the septum on which the scar tissue rests. In children, the operation is performed through the oral vestibulum. If the opening of the nostril is occluded, Walliczek's method should be used. Bockstein had a patient, a man, aged 22, who had a pronounced stenosis in both nostrils, 15 mm. behind the opening of the nose. The Wassermann reaction

was negative. Neither Koerner's nor Walliczek's method seemed applicable. The vestibulum was narrowed by elevation of the nasal floor and protrusion of the lateral walls. The author formed two flaps by a sagittal and a curved incision, excised the underlying fibrous tissue and resected the bone at the borders of the apertura piriformis for several millimeters, including the threshold of the nose. Then a pedunculated flap from the mucous membrane of the upper lip was transplanted into the nasal cavity and fastened by stitches. The two flaps mentioned were secured by stitches. The result was satisfactory.

AMBERG, Detroit.

## Miscellaneous

CHORIORETINITIS AND RECURRENT HEMORRHAGES INTO THE RETINA AND VITREOUS FROM MULTIPLE FOCAL INFECTION. DEAN E. GODWIN, Am. J. Ophth. **10**:171 (March) 1927.

Godwin reports a case of a man, aged 29, who, for three weeks had noticed blurring of the vision of the right eye and something like spiderwebs floating before it. He had had a severe nasal cold for the preceding ten days. Eight years previously he had had an attack similar to the present one, and he was subject to frequent attacks of rhinitis.

Examination of the right eye showed a slight scleral congestion, with the pupillary reactions, cornea and iris normal. The ophthalmoscope showed a slight cloudiness of the vitreous. The margins of the disk were indistinct. In the superior nasal quadrant was a small area of choroidal atrophy with massed retinal pigment. The vision in the right eye was 6/5+, and that in the left, 6/4—.

Rhinitis and pharyngitis of moderate severity were present. The nasal septum deviated to the right, the right nostril being considerably narrowed. There were medium-sized infected and congested tonsils with palpable and slightly tender cervical lymph nodes. There was a large amount of dental work in the mouth. The Wassermann reaction was negative. A roentgenogram of the teeth showed one devitalized tooth, with periapical absorption of the bone. The diagnosis was acute chorioretinitis; there was a scar resulting from an old area of chorioretinitis with retinitis proliferans, probably from hemorrhage eight years previously.

Potassium iodide was prescribed, atropine was used in the eye, the rhinitis was treated locally and the involved teeth were extracted. There was a gradual improvement, and six weeks after the first visit the eye was quiet, the vitreous clear and the vision 6/4—.

One month later the patient returned with a history of sore throat followed by rhinitis and with a return of the symptoms in the right eye. There was a central and paracentral relative scotoma in the right eye, the vision being 6/7.5—. Examination of the fundus showed, in addition to the previous observations, vitreous floaters and a triangular area of edema of the retina below the disk. Nasal treatment was instituted, and the next day all symptoms were worse, especially the muscular soreness on rotating the right eye upward.

It was evident that a purulent ethmoiditis was the cause of the muscle symptoms and a progressing acute chorioretinitis. The next day submucous resection of the nasal septum was performed, the right middle turbinate was resected, and the right anterior and posterior ethmoid cells were uncapped.

Following the operation, the area of edema below the disk did not increase; but a new and smaller one developed in the inferior temporal quadrant and

soon subsided. A few days later the inferior temporal artery became occluded where it passes through the edematous area below the disk, resulting in a large, pale area of ischemia below the macula and an absolute scotoma above. The vision dropped to 6/12. During the next ten months there was a gradual improvement in the eye, with vision 6/5+. During the following ten months the patient was not seen.

Over a year later he returned with a history that he had been ill with a sore throat and had been unable to work a few weeks previously. The day before returning for examination the right eye became suddenly blurred, and within half an hour vision had become poor. Examination showed a congested throat. Vision in the right eye was reduced to counting fingers at a distance one-half meter, eccentric, to the temporal side only. The fundus could be seen only on the nasal side, the disk and the temporal two-thirds being obscured by blood in the vitreous. The left eye was normal in every way.

As this new attack had immediately followed an attack of acute tonsillitis, the tonsils were removed three days later. The right eye, however, showed no improvement, the vision became progressively worse and the vitreous more cloudy during the following months. There were apparently successive hemorrhages, and vision was reduced to projection of light.

About this time there was a return of mild pain in the frontal sinus region, and though the ethmoid region continued normal a small amount of pus could be demonstrated at times in the region of the right frontal sinus opening. A roentgenogram showed a large, clear left frontal sinus and a small, cloudy right frontal sinus. The right frontal sinus was opened intranasally.

Previous to this operation the patient had complained of feeling tired after his day's work. On two occasions the temperature was found to be a fraction of a degree above normal. Results of a physical examination were entirely negative except for the presence of a few squeaky râles at the base of the lungs. However, as there was more than a suspicion that the condition in the eye might be of tuberculous origin, subcutaneous injections of old tuberculin were begun. Injections were given at intervals of about one week for the rest of the year, from February to December, and the dosage was gradually increased, starting with 0.0001 mg. and increasing up to 0.8 mg. which dosage was maintained. In all, forty-six injections were given, and no local or general reactions were noted.

During this time the right frontal sinus was repeatedly irrigated, and negative pressure was used. At first a small amount of pus was washed out; but as time went on, nothing but mucus or mucopus in slight amounts was obtained. The eye throughout this period, from the time of the first hemorrhage, Dec. 7, 1923, to January, 1925—thirteen months—had remained persistently in poor condition. At times the vitreous would apparently begin to clear, but most of the time only perception of light was present. There were repeated fresh hemorrhages. At times the patient could give the exact hour of the hemorrhage. About the middle of 1924, he noticed that when he could see a light it appeared double, and it was noticed that the right eye diverged and turned upward. Hope for recovery of the right eye was slight, and as the injections of tuberculin were evidently without effect, as a last resort it was decided to perform a radical frontal sinus operation, and in January, 1925, a Killian operation was performed. The frontal sinus was small and entirely filled with polypoid substance. Recovery was uneventful; vision improved, so that three months after operation it was 6/6+ and four months after operation 6/4.

There had been no hemorrhages in the eye after the operation on the frontal sinus. As the vision improved, the diplopia became annoying, but gradually cleared up.

The patient was last seen in December, 1925. Vision at that time was 6/4, though the upper half of the field of the right eye was obscured. The vitreous had cleared completely, and the fundus was clearly seen. The fields showed in the right eye a limitation in the superior nasal and also in the inferior temporal quadrants, and there was a small paracentral scotoma.

In the summary of this case, the author states that the history divides itself into several episodes, which are briefly: (1) a chorioretinitis with hemorrhage eight years before, of unknown cause; (2) a uveitis coincident with acute rhinitis, and clearing up following treatment of the rhinitis and extraction of an infected tooth; (3) a chorioretinitis and hemorrhage following immediately on an attack of acute tonsillitis, and (4) repeated hemorrhages persisting for thirteen months, causing blindness, not improved by injections of tuberculin, but clearing up promptly after a radical operation on the frontal sinus.

The conclusion is evident that in this case there was a clear relation between the appearance of chorioretinitis and intra-ocular hemorrhages, and that both were related etiologically to remote seats of infection. VAIL, Cincinnati.

ROENTGENOLOGIC PRESENTATION OF THE LACRIMAL DUCTS. HUGO STEDEFELD, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:7 (Dec. 18) 1926.

After dilatation of the upper and lower openings of the lacrimal ducts, the lacrimal sac is cleaned with a syringe, and iodipin is introduced. One-half cubic centimeter (or less) suffices. Two exposures should be made, one in profile and a fronto-occipital one. If the lacrimal ducts are permeable, the iodipin disappears in a few minutes. If they are not permeable, the oil may be squeezed out. It may also be removed by syringing, or may be left in place. Valuable information is thus procured by roentgenography concerning the normal and pathologic conditions of lacrimal ducts, their course, shape and size.

HISTOLOGY OF METASYPHILITIC DISEASE OF THE EIGHTH NERVE. MAXIMILIAN KRASSNIG, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:13 (Dec. 18) 1926.

Among the patients, one had paralysis, one had tabes, the other eight had tabetic paralysis. One of these showed tabes preeminently. The clinical investigations showed that metasyphilitic patients with pronounced disturbances of hearing suffered from pronounced tabes. Histologic investigations confirmed this view.

Certain microscopic changes occur in paralysis, according to Alzheimer, Nonne, Krause, Nissl and others. 1. In the pia, these changes consist of diffuse infiltration with lymphocytes, plasma, mast and granular fat cells, proliferation of connective tissue and new formation of blood vessels. 2. In the cortex of the brain, hypertrophy of the endothelium of the vessels and the adventitia, increase of blood vessels, swelling and infiltration of the sheaths of the lymph vessels are seen. Lymphocytes, mast cells, granular cells and products of decomposition are also found. Occasionally, there is hyaline degeneration of the vessels. Toward the surface of the cortex, an increasing loss of ganglion cells is found, also medullated fibers and fibrils. Independent of inflammatory changes, proliferation of the glia and degeneration of the parenchyma of the

nerves take place. 3. Jahnel and Jakob have shown that, in a paralysis, spirochetes cause proliferation of the connective tissue and of the parenchyma of the nerve.

The microscopic changes in tabes are: slight meningeal changes in the region of the posterior roots (Redlich, Obersteiner Bresovski) and degeneration of the posterior filaments of the afferent fibers of Clarke's column and of the so-called direct reflex-collaterals. Degeneration of Clarke's column begins outside of the spinal cord, between the spinal ganglion and spinal cord. Noninflammatory degeneration of the posterior columns with secondary proliferation of the glia occurs, emanating from the nerve roots. The reported diseases of the acoustic nerve, therefore, are closely related to changes in tabes and paralysis.

1. Few meningeal changes are found in the pia. They are most pronounced in the fundus of the internal meatus.

2. Not only meningeal, but also interstitial increase of vessels is found.

3. Frequently no inflammatory changes are found in areas in which parenchymatous nerve degeneration exists, but at times there are pronounced changes. Therefore, Alzheimer's view that the degeneration of the substance of the nerve is independent of inflammatory processes, is not substantiated. It is known that spirochetes are found in the substance of the nerve. As the authors have sometimes found inflammatory processes of the acoustic nerve in addition to degeneration, it is to be assumed that in metasyphilitic atrophy moderate processes of inflammation precede the degeneration or develop parallel with it.

4. The primary seat of the disease is found in the stem of the acoustic nerve. The ganglion cells in the labyrinth are affected secondarily. The distinction between tabetic and paralytic changes of the acoustic nerve is only one of degree. The quickly progressing cases of paralysis show more pronounced inflammatory changes in the membranes of the brain.

Metasyphilis of the ear is an inflammatory degenerative process which starts, typically, in the stem of the cochlear nerve near the fundus, and which extends toward the periphery as secondary degeneration.

Retromaxillary Conduction Anesthesia (A Preliminary Communication). Birkholz, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:176 (Jan. 31) 1927.

Two new methods of retromaxillary conduction anesthesia of the second branch of the trigeminus have appeared in the *Zeitschrift für Hals- Nasen- und Ohrenheilkunde*, that of Slobodnik and that of Carrea-Hofer, reported by Reddingius (the latter **13**:470 [Jan. 18] 1926).

The dental literature shows a series of contradictions, not only concerning the indication, but also concerning a number of accompanying faulty effects. In this respect, Birkholz agrees with Slobodnik. It appears to be inadvisable to introduce a needle for several centimeters toward the base of the skull. Theoretical doubts have been strengthened by the author's study of the diameter of the canalis pterygopalatinus in twenty-nine skulls, its length, its direction, its ending at the base of the skull and its relation to the orbit and endocranium. It is difficult to state an average distance that a needle can be introduced with safety on account of variations in the adult skull. The orbit may be injured at its most dangerous retrobulbar spot. Sections in frozen specimens have shown the narrowness of the channel and the relative width of the palatine vessels, so that it would be strange if these were not hit. Hubmann has seen this occur. In the living, the danger of orbital complication is comparatively

small. By observing the depth of 3 cm. when introducing the needle, the orbit will scarcely be injured through the inferior orbital fissure, and the strongly developed periosteal fold, which occludes the fissure at its lower portion, furnishes a protection against diffusion. The ubiquitous employment of the Carrea-Hofer method must be decried. Dentists do not infrequently break the needle. It is difficult to remove it from the pharynx. It is superfluous to mention the result of an accidental breaking off of the needle within a tortuous pterygopalatine channel.

Theoretical and practical reasons justify the author in calling attention to the dangers of the Carrea-Hofer method as a method of choice. It is not better than the older, especially the outer, methods. When the author used the method as a modification of the Wagener-Tonndorf procedure of palatine anesthesia for tonsillectomy and in premaxillary operations, he noticed that the reaction in the bed of the tonsil was much stronger and longer than usual, and that hematomas at the upper pole, necrosis of the mucous membrane and edema of the uvula developed much more easily than before. Severe and lasting reactions in the soft parts of the cheek in facial operations of the maxillary antrum (according to Denker) have occurred after this method. Besides, the anesthesia and the control of hemorrhage during the operation were not satisfactory.

Birkholz made two observations. 1. A moderate arterial hemorrhage from the puncture channel occurred each time. 2. Disturbances which the author considered to be trophic repeatedly set in.

AMBERG, Detroit.

# Society Transactions

## SECTION ON OTOLOGY AND LARYNGOLOGY OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

*March 16, 1927*

GEORGE M. COATES, M.D., *Chairman, pro tem.*

OTITIC MENINGITIS. Presented by DR. E. B. GLEASON.

Prompt myringotomy and early mastoid operation, if necessary, are the best measures of avoiding otitic meningitis. Many patients with acute otitis media showing cervical rigidity and other symptoms of meningitis promptly recover when these operations are speedily performed. In cases in which the patients do not so respond but develop a true meningitic process, the disease begins as an osteomyelitis with infection of the meninges as soon as, or before, the aural mucosa. Most all fatal cases of aural intracranial complications terminate as septic leptomeningitis.

Two clinical varieties of leptomeningitis can be differentiated. The serous or protective type and the purulent or infective. The finding of bacteria in the spinal fluid establishes the diagnosis of the latter variety. The treatment for the serous type is rest in bed, the use of an ice cap, and the diminution of intracranial pressure by purgation with magnesium sulphate. Repeated lumbar puncture is dangerous as it may spread infection. Administration of methenamine in 20 gr. doses, three times a day, is advisable.

Otogenic leptomeningitis usually begins as an extradural abscess. At its outset it is a localized infection of the cerebrospinal fluid and meninges. Surgical treatment consists in removing the source of infection aided by appropriate medication and diet. The identity of the organism in the spinal fluid should be learned and serum therapy inaugurated in certain types. Ethyl hydrocuperin hydrochloride injected intraspinally has been used in pneumococcus infections. Ventricular or cisternal puncture in connection with lumbar spinal puncture has been advocated and used by some for the purpose of washing out the subarachnoid space with saline or other solutions.

### DISCUSSION

DR. FRANCIS CLARK GRANT: Kolmer has recently reviewed the subject of the use and value of intraspinal solutions and serums in meningitis. He concluded from this study that neither chemicals nor antibody solutions so used favorably influence the disease if used alone. If they can be used with adequate surgical drainage, life can be prolonged and saved in some cases. This was experimentally demonstrated on dogs. Dandy advocates cisternal drainage in staphylococcic and streptococcic meningitis. In the pneumococcic types the pus is too thick for efficient drainage.

As almost all cases are fatal, I believe that radical measures are justifiable and advocate immediate surgical drainage. Chemotherapy and serum therapy should be used in conjunction with the surgical procedure.

Dr. Robert J. Hunter: I have applied the methods of Kolmer and Eagleton to several cases. Saline irrigation from ventricles to cisterna was performed in one case in which there was temporary improvement. In two other cases the advice of Dr. Grant was followed. Wide mastoid operations were performed, the labyrinth removed and the cisterna drained in this region. All cases ended fatally. The danger of early surgical intervention is the difficulty of establishing an absolute diagnosis of meningitis. Only when bacteria are found in the spinal fluid is this certain. Patients with meningismus recover following mastoid operation alone. Probably many cases of meningismus would become true meningitis if the operation was not performed promptly.

Dr. J. MacEwan Smith: The prevention of otitic meningitis is best accomplished by early myringotomy and mastoid operation to get rid of the infective focus. Lumbar puncture readily establishes the diagnosis of meningitis. In my experience, cisternal drainage, repeated lumbar puncture and intraspinal injections of methenamine have all been of no value when infective meningitis has been established.

Dr. George M. Coates: Thorough eradication of the focus of infection is most important. All diseased mastoid cells, as well as those that may become diseased, should be removed. Some patients who show symptoms of meningitis recover following mastoid operation. In these cases the condition is probably localized. If a radical operation is performed before bacteria appear in the spinal fluid, then the operation may have been done on a patient who would have recovered after more conservative measures. Eagleton advises carotid ligation in order to put the affected parts at rest.

Dr. Gleason: We are approaching better results in the treatment of otitic meningitis.

### Bronchial Cyst Encroaching on the Larynx Causing Fatal Suffocation. Presented by Dr. W. R. Watson.

Dr. Watson exhibited a pathologic laryngeal specimen in which there was a bronchial cyst which apparently was an integral part of the larynx; a portion of which formed a "ball-valve" glottic obstruction. The cyst entered the larynx in the right ventricle and extended downward to lie over the vocal cords.

The patient had been admitted to the Episcopal Hospital with a diagnosis of bronchial asthma. Her first respiratory trouble began six months before admission, at which time she was told she had asthma. She was then relieved by hypodermic medication. These attacks became more frequent and severe, until she was finally sent to the hospital as having an atypical case of bronchial asthma. Her speech was normal. On admission she was cyanotic but not laboring for breath. It was noted, on examination of the chest, that inspiration would proceed normally to a certain point then suddenly stop. No signs of asthma were found. The patient was admitted at midnight and died the following morning. No laryngeal examination was made.

#### DISCUSSION

Dr. Fielding O. Lewis: Often patients with a pathologic condition of the larynx are treated over long periods of time for bronchial asthma. Laryngeal stenosis and asthma should always be differentiated. If the patient cited had been seen earlier, a tracheotomy could have been done and later followed by appropriate laryngeal surgical procedure.

UNUSUAL MANIFESTATION OF MASTOID DISEASE WITH LATERAL SINUS THROMBOSIS. Presented by DR. AUSTIN T. SMITH.

In December, a man, aged 26, suffered from a cold in the head and pain in the left ear. At the end of a few days he had apparently recovered, except for a hissing noise in the affected ear which persisted for several weeks. About five weeks after his initial symptoms, he developed a severe pain in the left ear associated with some mastoid tenderness but no aural discharge. The left auricle was pushed forward, a diffuse external otitis was present, the temperature was 99.2 F., and there was roentgen-ray evidence of bone destruction and a probable perisinus abscess of the left mastoid. This condition improved so much that operation was postponed for ten days. At that time, however, the pain and swelling returned.

At operation subperiostial pus was found which had escaped from the mastoid by way of the emissary vein. Much bone destruction, thrombosis of the lateral sinus and a large perisinus abscess were found. The antrum was sealed off by sclerosis and was opened with difficulty. On culture, the pus was found to be sterile. An appropriate operation was performed, and an uneventful recovery followed.

DISCUSSION

DR. HUNTER: I wish to refer to the case of a child who developed acute otitis after a fall. An occipital mass was present that proved to be subperiosteal pus that had escaped through the emissary vein. This vein was followed until free bleeding was obtained where it was ligated. The sinus was not disturbed. The recovery was uneventful.

SPONTANEOUS RUPTURE OF THE LATERAL SINUS. Presented by DR. HORACE J. WILLIAMS.

Dr. Williams presented the case of a 5 year old child on whom a mastoid operation had been performed. The sinus had been exposed at the time of operation on account of softening of the sinus plate. The sinus itself was not thrombosed. The wound was drained by a small rubber tube, which was placed in the antrum and which brought out the inferior angle of the opening. The skin was closed by metal clips. On the fourth day the skin was healed and the clips removed. On the seventh day a profuse hemorrhage occurred, blood escaping around the tube and lower angle of the wound. The skin incision was immediately opened and the bleeding controlled by packing. At the end of eight days the packing was permanently removed, with no further bleeding. Recovery was uneventful.

DISCUSSION

DR. HUNTER: Spontaneous hemorrhages of the ear as reported in the literature rarely are attributed to rupture of the sigmoid sinus. Often when aural hemorrhage does occur the internal carotid artery is involved. Politzer states that all carotid ruptures are fatal, but probably some of the cases of hemorrhages of the ear in which the patients recover are really of carotid origin. The rupture of the carotid usually occurs at the bend. It would be possible in such cases to ligate the carotid artery in the neck and again above this bend by opening the mastoid cavity.

DR. LEWIS: I have seen a patient with tinnitus and slight deafness. This tinnitus was relieved by carotid pressure. With an auscultation tube in the ear, a bruit could be heard. This bruit could also be heard with a stethoscope in the temporal side. On roentgen-ray examination the outline of a possible intracranial growth was discovered.

DR. COATES: I once saw a case similar to the one reported. The patient, however, had unrecognized thrombosis of the jugular bulb, and the hemorrhage was possibly due to pressure from above. Then, too, a drain in contact with the sinus wall may have caused traumatic erosion.

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